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The Journal of HEREDITY

A TWENTY-ONE CHILD FAMILY

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I. Q's of Twins Reared Together

What Causes Twisted Trees?

VOLUME 23 FEBRUARY, 1932 NUMBER 2

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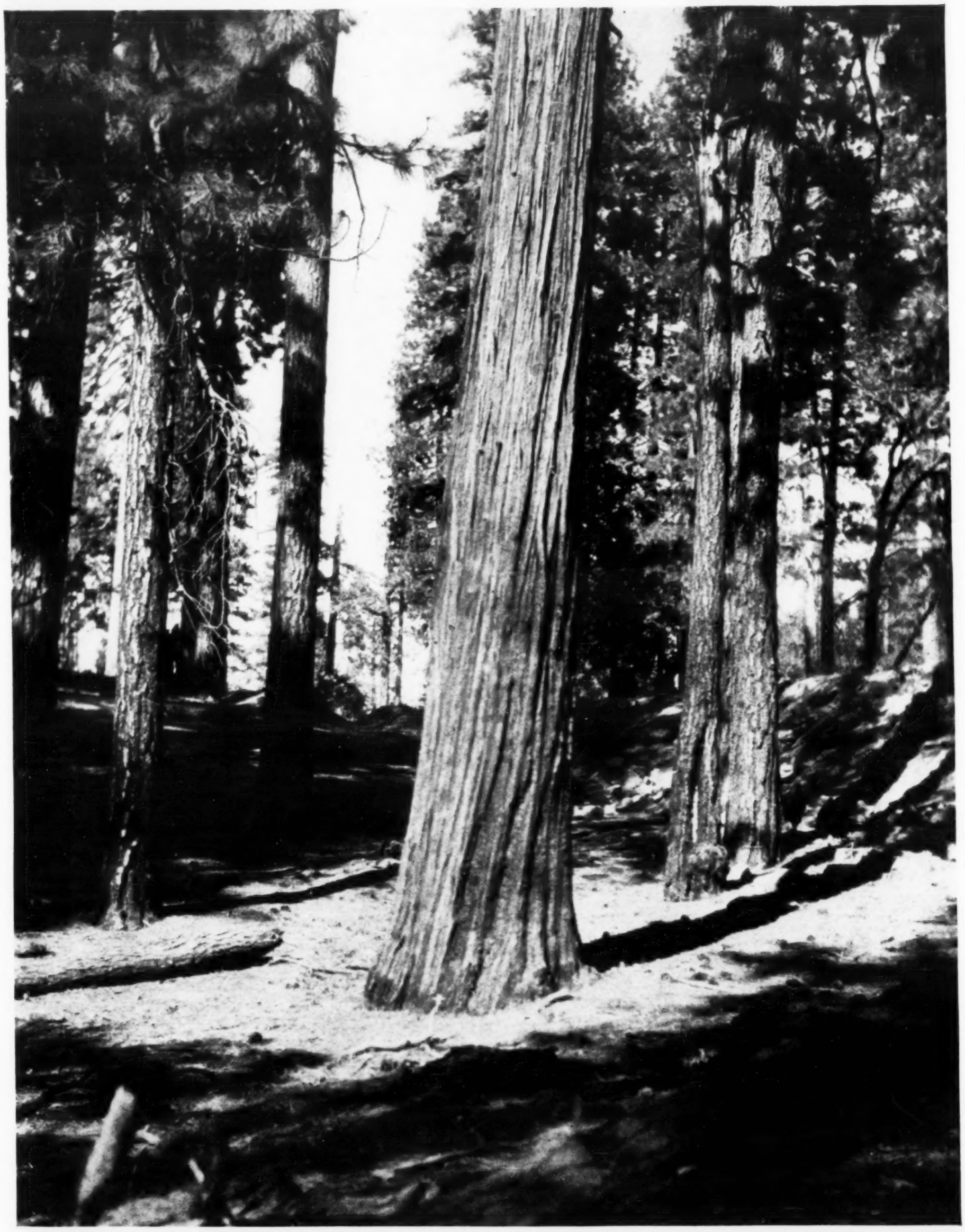

IS THE TWISTED TRUNK CAUSED BY THE WIND?

Frontispiece

A number of causes have been suggested to account for trees having twisted trunks. While in some situations solar action or wind action might appear to be the cause, in other instances it does not account satisfactorily for the phenomenon. In the same species trunks of twisted trees can be found with a clockwise twist or with a counter clockwise twist. This tree of California White Cedar (*Libocedrus decurrens*) has a pronounced clockwise twist, as viewed from the base.

WHAT CAUSES TWISTED TREES?

F. KNORR

Modesto Junior College, California

IN the summer of 1925 our attention was attracted to a large number of twisted trees located near the summit of the Sonora Pass in Alpine County, California. At an elevation of 8,398 feet there was an unusually large group of Jack Pines that were twisted counter-clockwise. Why such a large group should be twisted in that direction with but a very few exceptions, naturally excited our curiosity.

Consulting with the forest ranger of that area regarding the possible causes contributing to this phenomenon, we were surprised to learn that he had never noticed this twisting, and had never given any thought to this condition and remarked: "no doubt it is due to the wind."

During the remainder of the summer we had an opportunity to question a number of sheep and cattle herders relative to twisted trees; we found a number of individuals interested in the problem and practically all attributed the cause to wind action or the "pull of the sun."

The theory of the sun action being that the young tree follows the sun after the same manner as the sun flower, facing the sun in the morning and again facing it in the evening. The theory did not seem feasible. Even though the plant made a half turn during the day it did not seem possible that it would continue to twist and make a full turn to face the sun in the morning. Flowers following the sun swing back the same way they turned during the day.

The wind theory seemed more plausable. In an effort to verify this, observations were made the following summer in such canyons where the winds were constant or had an opportunity to blow at the trees from a definite angle and would, therefore, exert the same force on all of the trees in that particular area. At the end of the season of 1926 we found that out of 486 twisted trees that we checked, 56 per cent were twisted counter clockwise and 44 per cent were twisted clockwise. These data did not impart any special information except that the chances were about even that the wind would blow as many trees in one direction as the other. Like the instances brought forward by Cooper[1] and Wentworth,[2] these observations did not offer an altogether satisfactory solution of the problem.

One Quarter of Trees Twisted

In the early part of the summer of 1927 we ranged in the big timber, the *Sequoia gigantia*. At this time we began to check the straight as well as the twisted trees in certain areas. Later in the same season we made an extensive count of the Western Yellow pine. the Jeffry pine, Sugar pine, White fir and the Incense Cedar.

The check was made regardless of species; of 822 trees counted it was found that 73 per cent were straight and 27 per cent twisted. Of the twisted trees 52 per cent were twisted clockwise and 48 per cent counter clockwise.

There were some errors in this count due to the fact that all trees do not give an exterior indication of the nature of their growth; the bark is of such a nature that it does not always twist as does the wood. This is especially true of the Firs and the Sugar pines.

Again our work seemed inconclusive, except insofar as we were convinced that the wind was not a causative factor, several exposed areas where wind action was constant showed as low as two per cent of

TWISTED TRUNKS OF WESTERN YELLOW PINE

Figure 1

The trunks of these pine trees have both a clockwise twist. The one to the right is much more twisted than the other. If these twisted trunks are produced by genetic causes, the lumbermen's custom of leaving twisted trees as seed-trees, would be expected to increase the number of twisted trees rather rapidly in later generations.

twisted trees. Again, if wind, direct or indirect, is the cause of twisting, then by far the larger percentage of trees should show a decided twist. After the year's work we concluded that certain species in some areas twisted more than other species.

In the summer of 1928 the method of procedure was again changed. An improvised chart was made of tree groups, on this the trees were plotted, showing the relative locations of the species and the nature of growth. This procedure made observation very laborious. Much data were collected during the season of 1928 and 1929. This material was most interesting but proved to be difficult of interpretation. It was found that in a certain area where three or four species of trees abounded only one species would show twisting; in other sectors two or three species would show twisting. There was absolutely no relationship in the number of twisted trees in one area as compared with those in another location.

Is Twisting Inherited?

We were now fully convinced that neither the wind nor the sun were the contributing factors that cause twisting. The theory that twisting is due to impoverished soil or hard subsoil was not substantiated as we found many well grown, thrifty but twisted trees growing in deep alluvial soil; the gnarling of trees may be due to slow growth in hard semi-sterile soil but not twisting. In 1930 we came upon some old Junipers near the timber line, an old tree that was all but

destroyed had sent up three sturdy young trees from the base, these three trees were twisted in the same direction as the parent tree; we grasped the idea, twisting is inherent in the roots. A trip into the *Sequoia sempervires* forests of California verified our conclusions. These trees, as is well known, send up new growth from the roots of the fallen trees or from the fallen trees themselves. Here we found that these "rootlings" always produced the same type of growth as found in the original tree.

Secondary growth of some deciduous trees was studied, again it was found that such growth was of the same type and nature as the original. We were now fully convinced that climatic conditions did not influence type of growth.

Late in the fall of 1930 we felt convinced that twisting must be an inherent condition. A study of the charts made a few years previously confirmed this belief, and with this in mind a study was made of the young growth. The trees used were taken from dense growth areas where thinning was necessary and in one case where a clearing was made for agricultural purposes. The trees were from four to ten feet high; it was necessary to peel the bark in order to determine the nature of the wood growth. In this group of trees composed of four species a very small percentage of Sugar pines showed twisting.

A TWISTED SEQUOIA

Figure 2

A potential giant of the California forests (*Sequoia sempervirens*) with a counter clockwise twist. Secondary growths and "rootlings" from twisted trees are found to produce trees twisted in the same direction as the original tree. This is a strong indication that the twisting is not due to environmental causes.

Twisting of Seedlings

In 1931 we had access to a large number of seedling conifers ranging from two years of age to about six years. The trees were pulled up by the roots, the bark was immediately stripped from the tree and roots, this was easily accomplished while the plant was fresh.

Of the 261 conifer seedlings thus studied it was found that twisting is apparent as soon as the woody tissue is formed and that it carries the same intensity of twisting below the ground as above the ground. Carrying these findings to older groups of trees we find that the branches and twigs all show the same characteristic twisting.

One extremely interesting study was made of a freshly felled White fir that had a very decided twist; we wished to determine if the intensity of twist is equal in all parts of the tree. On this tree it was found that the intensity of twist varies slightly even on the same branch.

A further study of the twisting characteristic of lumber-yielding trees would be interesting and of economic

value. Twisted trees produce lumber in which the grain "runs out," does not split straight and is therefore much weaker than straight lumber. Some of our work leads us to believe that twisted trees grow slightly slower than straight trees and are more subject to "wind falls" (i.e., to being broken off by high winds).

We have found several areas where the lumbermen permitted twisted trees to stand as "seed trees" in order to reseed a cut-over area, these being the most worthless trees from a lumber or economic standpoint. If twisting is an inherited characteristic the folly of such a course is obvious. We tried to determine the intensity of inheritance of the twisted seedlings surrounding such twisted trees but had to abandon that phase of the work because of the inaccuracy that is inevitable under uncontrolled conditions.

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WENTWORTH, C. K. 1930-31. *Science,* Vol. 73, No. 1891, and Vol. 74, No. 1927.

COOPER, W. S. 1931. *Ibid*, 74, No. 1905.

Evolution and Genetics

MENDELISM AND EVOLUTION, *by* E. B. FORD. Pp. xii + 116. $1.50. Lincoln MacVeagh (The Dial Press), New York. 1931.

THIS little volume in the "Dial Press Monographs on Biological Subjects" will prove to be of real service to genetics because it presents in untechnical language the evidence which recent discoveries offer toward a solution of the general problem of organic evolution. And still more important, the evidence is so rationally interpreted and the conclusions so logically presented that the intelligent reader, even with no previous knowledge of the subject, can hardly fail to see that the processes taking place in the laboratory and in nature today must be similar to those that have produced the multiplicity of organisms of the past and present.

The author quite properly stresses the importance of the internal as well as the external environment in controlling the effects of individual hereditary factors. This internal environment, which depends upon the interaction of the entire hereditary complex, is too frequently neglected in interpreting the effects of particular genes, leading to erroneous conceptions as to the potency of the gene itself. Although it is evident that all genetic factors have their origin in spontaneous mutations, it is unnecessary to assume that any particular mutation was immediately of survival value, for later changes either in external or internal environment may cause even a previously disadvantageous factor to become essential to the individual. The chances for survival, however, will always be in favor of a mutation which is immediately advantageous.

Each of the five chapters into which the book is divided, namely, particulate theory of inheritance, heredity and environment, experimental genetics and its bearing on evolution, the application of the mendelian theory to evolutionary problems in nature, and special problems of evolution, is followed by a brief summary giving in a few words the essential conclusions from the evidence presented. It is a surprise to find that the evolutionary picture can be adequately sketched in so small a compass and without the omission of any of its essential features.

The book deservies the highest praise and can be recommended to anyone who desires to know to what extent the evolutionary problems have now been solved. There is a helpful list of references and a glossary of the few technical terms employed.

WESLEY R. COE.

IDENTICAL TWINS REARED TOGETHER[1]

HAROLD D. CARTER*

Stanford University, California

THE few detailed studies[3, 5, 6] of identical twins reared apart have contributed very interesting data concerning the effects of nature and nurture on mental traits. Some of these pairs have shown pronounced similarities but others have shown consistent differences. The results have no clear-cut interpretation, partly for the reason that the numbers of cases reported are as yet rather small.

H. J. Muller[5] has reported a case of identical twin women about 35 years of age. They were brought up in different homes, and one had considerably more schooling than the other, but their home environments were roughly comparable. They were very similar in performance on intelligence tests, and somewhat different in non-intellectual traits. Newman has reported[6] a study of another pair of twin women, aged 27, who had been brought up in different homes. Like Muller's subjects, they had similar home environments and one had much more schooling than the other. However, in this case the more schooled twin was slightly superior in all intellectual preformances (the I. Q. difference was 12 points), but the two were remarkably similar in all tests of emotional traits and temperament.

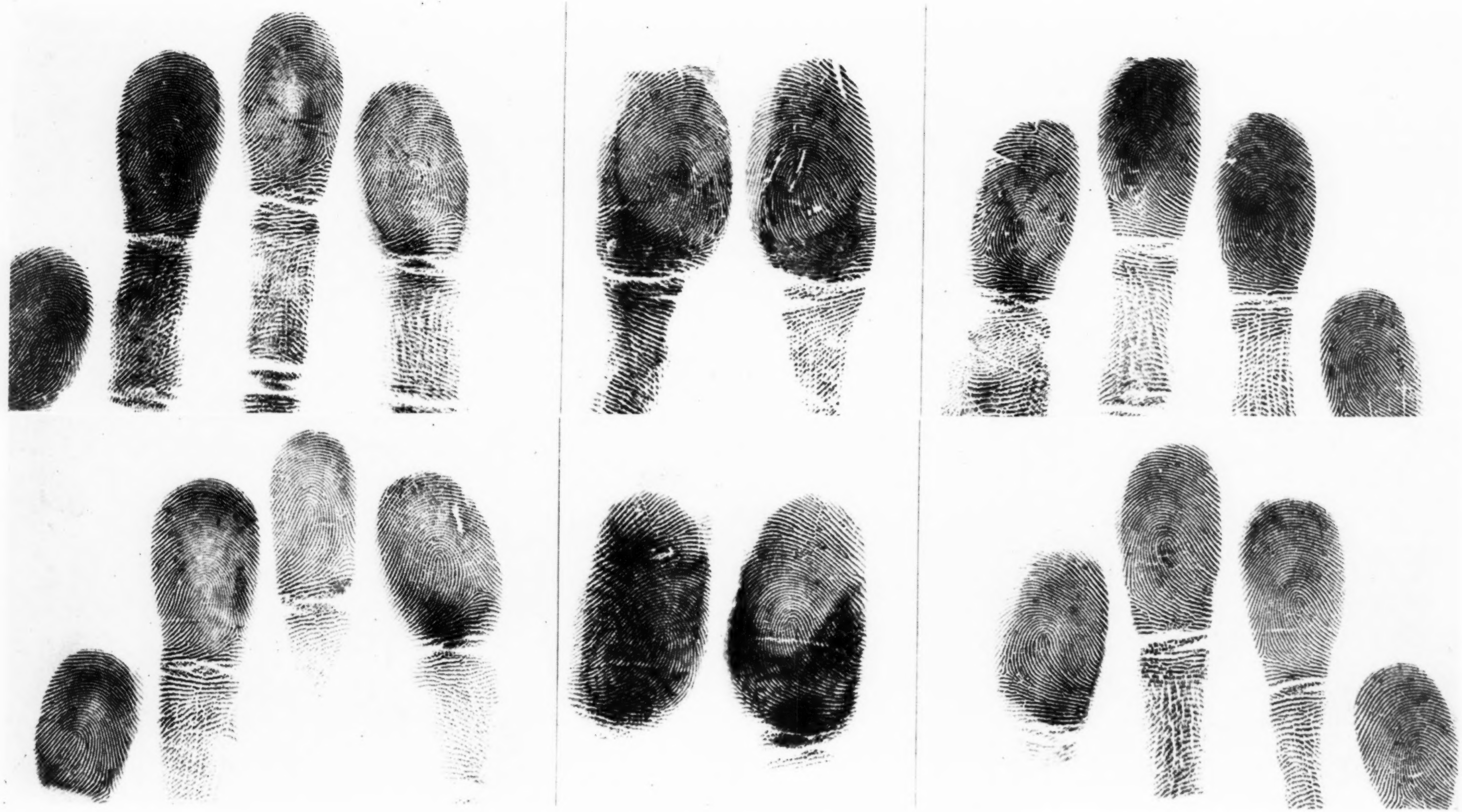
Newman[6] reports two other very interesting cases. A pair of twin girls aged 17 were brought up separately in different home environments but each received about the same amount of schooling. They were very similar in temperament and emotional makeup, but the one with the superior home environment was consistently somewhat superior in all intelligence tests (the I. Q. difference was 12 points). In another case study a pair of identical twin men are described, who had a similar amount of school training and whose environments were very different, one spending most of his time in cities while the other had an essentially rural environment. Mental tests revealed close similarity (the I. Q. difference was two points) but the twins were very different in non-intellectual traits.

There is no consistency of results in the several cases; where the home environments have been different, the twins differ in intellect and are alike in personality traits in one case, and the reverse is true in both respects in the other case; where the schooling has been different, the twins differ in intellect and are alike in personality traits in one case, and in the other case the reverse is true for both traits. No explanation in terms of environmental factors affecting intellect and personality is consistent with all the results obtained.

To aid in the interpretation of the results, Newman furnishes statistical data obtained on 50 pairs of identical twins reared together. By this means he is able to show which differences are significant. He notes that in five of the cases of identical twins reared together the I. Q. differences were zero; also, in five other cases the I. Q. differences were as large as those obtained in the two cases of identical twins reared apart where an I. Q. difference of twelve points was found. However, the differences shown by several tests were consistent for the pairs reared apart, while for those reared together

---

* This work was done by the writer as part of a more extensive investigation of twins which he is carrying out at Stanford University under the direction of Dr. Lewis M. Terman. These studies were made possible by a grant from the Social Science Research Council. The complete data will be published later.



FINGER PRINTS OF TWINS B.E. AND L.E.

Figure 3

These twin boys of fourteen years of age are so much alike that they are frequently mistaken for each other by friends and relatives, and even by their father. While *B* tends to be left-handed, the fingerprints are of the type showing remarkable same-sided similarity. In fact they are much more similar than are the fingerprints of many other pairs of identical twins. In spite of a similar environment all their lives the twins record nearly a year's difference in educational age, though only four points difference in I. Q.,

data obtained by use of different tests did not by any means reveal such consistency. This of course creates the impression that the differences found for the twins reared together were random differences. The really important finding is not the size of the differences, apparently, but the fact that different tests consistently show a difference in the same direction for the twins reared apart.

Statistical studies citing average differences show that pairs of identical twins will exhibit great similarity of ability on the average. In such studies it is always possible to interpret even differences of considerable magnitude between members of a particular pair as the expected result of the operation of chance factors. The data reported here, however, suggest that such differences may not always be random fluctuations, but may be representative of stable differences. The writer believes that intensive studies of identical twins reared together are needed as controls for studies of identical twins reared apart. A fundamental truth is stated in Newman's assertion that each case of twins reared apart is a special problem; it also appears that each case of identical twins reared together also constitutes a special problem.

This paper summarizes the results of studies of identical twins brought up in environments essentially similar for the members of each pair. In each case the diagnosis of identity was based on the techniques outlined by Bonnevie[1], Dahlberg[2], Siemens[8], Newman[7], Muller[5], and others. The findings are merely summarized. Differences and similarities of environment are briefly described. The results of personality trait measurement are given without any attempt at exact evaluation of scores; it is assumed that those results give some insight into the situation, but careful evaluation must be based upon statistical treatment of larger numbers of cases. In view of the unreliability of instruments for measuring personality traits, the results of ability tests are given slightly greater emphasis. Only four cases are considered here, but others will be reported as the investigation continues. The statistical evaluation of the differences is left for later more detailed treatment. The argument here rests upon the consistency with which the results are obtained.

Case I. B.E. and L.E.*

Twins *B* and *L* are boys fourteen years of age. They belong to the extremely similar class of identical twins. Examination by the above-mentioned accepted techniques clearly demonstrated that they are monozygotic.

Their environments have always been very similar; they have the same home, the same school training, the same friends; they spend nearly all of the 24 hours of each day together, and have never been separated even as long as over night except in case of illness. They have had the same illnesses at the same times, excepting that *B* has had pneumonia and *L* has not.

The Strong Vocational Interest Test was scored for interests in 23 occupations, and great similarity of results obtained. The Bernreuter Personality Inventory was given twice, and in both cases *B* was clearly more introverted, less self-sufficient, and less dominant. An 80-item information test showed that *L* is more inclined to overstate his abilities. The difference in scores on the Masculinity-Femininity Test indicated that *B* has more of the mental traits associated with masculinity. *L*'s score on the Meier-Seashore Art Judgment Test was slightly higher, but neither twin shows any particular aptitude for art.

Direct questioning of the mother resulted in statements that the twins were of equal ability, but answers to specific diagnostic questions scattered about in a questionnaire indicated that she considers *B* brighter. She reports that *B*

* A preliminary account of the detailed results on this case was given in a report at the meetings of the Western Psychological Association, at Eugene, Oregon, June 13, 1931.

FINGER PRINTS OF TWINS D.C. AND T.C.

Figure 4

The finger prints show same-sided symmetry and the twins are both right-handed. In spite of physical and mental differences at 38, the fingerprint patterns alone are almost conclusive evidence that they are identical twins. Their environment was very similar until they were eighteen, and has differed somewhat since that time. At the present time the twins differ twelve points in I. Q., and thirty pounds in weight. This difference is nearly as large as the greatest difference found by Newman in twins reared apart since early infancy.

reads more. Their home-room teacher states that *B* is brighter than *L*, but another teacher failed to notice any differences.

The differences here are not as large as those found by Newman for two cases of identical twins reared apart, but they are larger than those found for the two other cases of identical twins reared apart. It is thought that such consistent differences between identical twins are comparatively rare, but the findings require explanation. Is *B* superior because he reads more, or does he read more because he is superior? Is he a better scholar because he is more introverted, or is he more introverted because he is a better scholar? These questions can better be answered when data are available for comparison of a number of cases of this type.

Case II. D.C. and T.C.

In determining the difference between identical twins reared together, it is perhaps desirable to select cases representing different age groups, so as to exclude the possibility of the differences being due merely to variations in rate of maturation. Here we must take strict account of any environmental differences, and view the situation as a whole in the attempt to see some significant trend in the data.

D and *T* are twin sisters aged 38. At present they are superficially different in appearance, as *D* is 30 pounds heavier, much stronger, and is tanned by exposure to the sun, occasioned by gardening. However, there is great similarity of stable features such as height, form of face, fingerprint patterns, color of hair and eyes, etc. The data are such as to justify a diagnosis of monozygosity on the basis of the criteria usually employed.

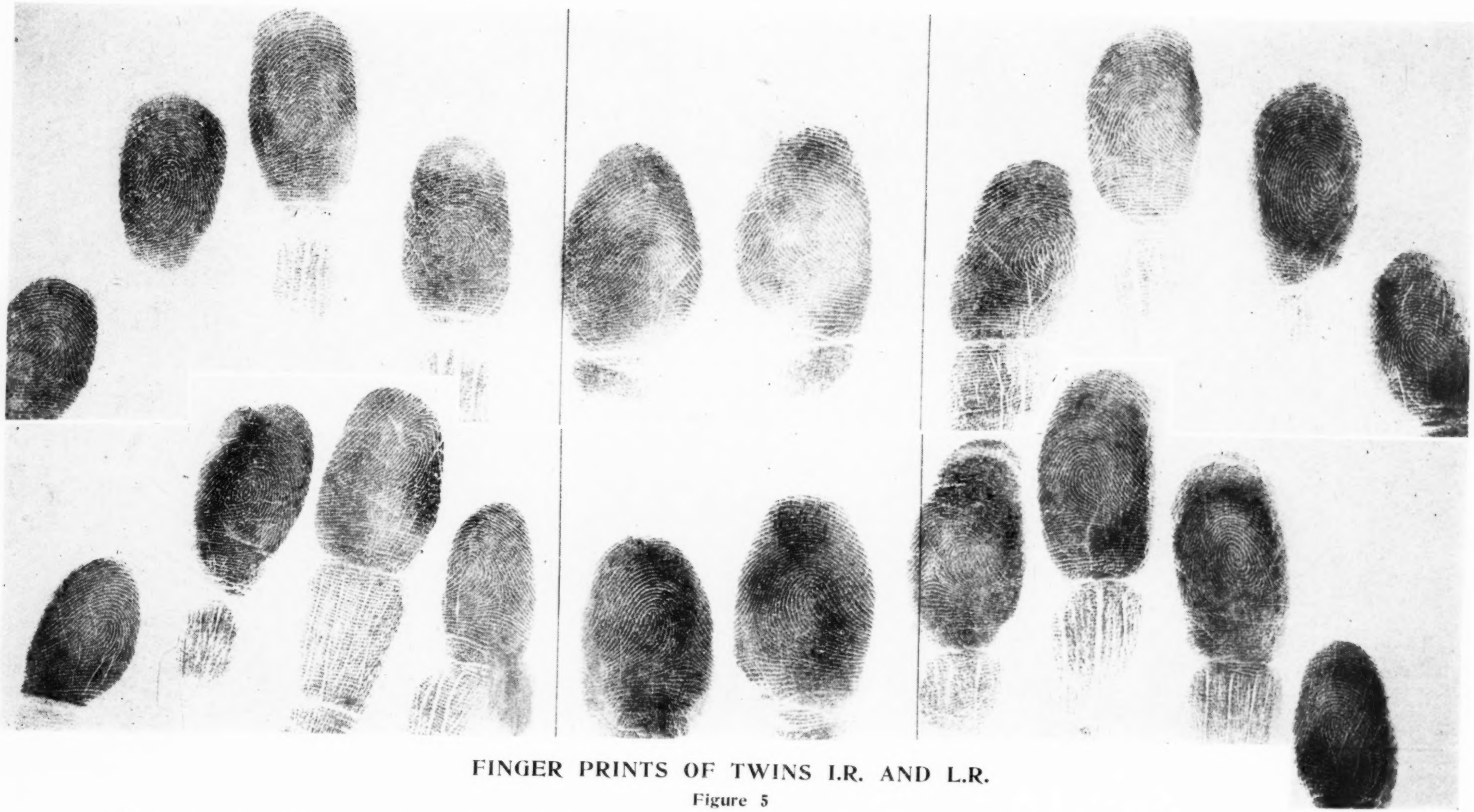
Their environments have been extremely similar in early life, but increasingly different since age 18. *D* had two years of highschool training, and *T* left after one year. *T* spent 15 months in business college, and *D* entered later and completed the same course in 9 months. During the last decade, *T* has had an environment which offers more social contacts, and more opportunity for cultural development, intellectual advancement, and the pursuit of knowledge. Her husband having died seven years after their marriage, she has worked in the Y. W. C. A. for nine years, as General Secretary. She has only three children, while *D* has seven; when the children were young, *D* took care of all of them

TABLE I . Results of Tests of Intellect and Achievement—Case I.

	B's Score	L's Score
Terman Group Test, at age 14-2		
Raw score	37	27
I. Q. Equivalent	81	77
Vocabulary tests*		
Test A	38	26
Test B	31	20
Test M (Very difficult)	29	25
Stanford Achievement Test		
Total Score	778	688
Educational Age	12-3	11-5
Grade Level	6.4	5.6
Willoughby battery of 11 tests		
Total score	208	182
Stanford-Binet Intelligence Test		
Mental Age	12-3	11-10
I. Q.	83	80

* Vocabulary tests taken from the University of Minnesota College Aptitude Test. Tests A and B combined have a reliability coefficient of .92 for adults, or for children in homogeneous age groups. Each test takes 15 minutes.

At the present time the twins differ twelve points in I. Q., and has differed somewhat since that time. At eighteen, the greatest difference found by Newman in twins reared apart since this difference is nearly as large as the g thirty pounds in w early infancy.



FINGER PRINTS OF TWINS I.R. AND L.R.

Figure 5

The twins were sixty years of age when the tests were made. *I* is strongly right-handed, but *L* shows a tendency to be left-handed. The finger prints show decided same-sided symmetry. *I* and *L* have had a remarkably similar environment, even for twins, in spite of which very definite differences were noted, especially in their personalities.

while *T* worked at the Y. W. C. A. Housework occupies all of *D*'s time. They have very similar interests, as determined by the Strong Vocational Interest Test. *D* mentioned gardening as a hobby, while *T* stated that she is interested in the problems of young people and in work of the kind she does in the Y. W. C. A.

On the Bernreuter Personality Inventory, *D* was found to be more self-sufficient, more dominant, and more extroverted. An 80-item test of information showed that *T* has a greater tendency to overstate her knowledge, and indications obtained in an interest rating scale also showed that she is more inclined to overstate. Scores on the Masculinity-Femininity Test indicated that *T* has considerably more of the mental traits of femininity. *T* has 17 psychoneurotic symptoms and *D* has 12, as determined by answers to the Woodworth-Cady Questionnaire; in other words, *D* is more stable, although the difference is slight. Ratings by their daughters and their nephew agree that *T* is more excitable, obstinate, and unruly, and has a greater liking for responsibility. These raters agree that *D* is easier to get along with, more practical and sensible, and more good-natured.

D's consistent though slight superiority on the vocabulary tests is surprising in view of the fact that the twins and their daughters and nephew unanimously report that *T* reads more. Their vocabulary scores approach the mean of 91 for college freshmen on tests *A* and *B*.

T reports that *D* is brighter than she herself is, and always did better work in school. The differences of course are very slight, but their consistency indicates that they are not mere random fluctuations. Whatever the cause, the differences are stable, and indicative of something in the fundamental make-up of the twins. We believe that the environmental factors have been such as to favor a difference in the other direction, and the findings are therefore all the more significant as an indication of mental superiority on the part of *D*. The greatest difference is not in achievement test score, but instead it is found in the scores on the Terman Group Test, where the I. Q. difference is twelve points.

In this case it is the superior twin who is more extroverted, more self-sufficient, and more dominant, while in Case I the opposite is true. Here the superior twin reads less, while in Case I the superior twin reads more. It is interesting to note that of all the cases reported in this paper, the environments have been most different in Case II, but the differences, with the exception of the Terman Group Test results, have been smallest; furthermore, all these differences are in the direction opposite to that in which the environmental differences would lead us to expect them.

TABLE II. Results of Tests of Intellect and Achievement—Case II.

	D's Score	T's Score
Vocabulary Tests		
Test A	88	84
Test B	91	83
Test M (very difficult)	72	67
Stanford Achievement Test		
Total Score	1097.5	1067.0
Educational Age	17-0	16-6
Total Score	393	388
Willoughby battery of 11 tests		
Terman Group Test Form A		
Total Score	185	146
M. A. Equivalent	18-4	16-5
I. Q.	114.6	102.6

Case III. Twins I.R. and L.R.

Twins *I* and *L* are men in the sixties. Careful examination reveals a great physical similarity. Their body builds are very similar, and unlike those of their siblings; their fingerprints show the close resemblance peculiar to identical twins, and bodily measurements are strikingly alike. There was no difficulty in arriving at a diagnosis of monozygosity.

Their environments have been very similar in most respects. They have always spent a great deal of time together; they have had the same amount of school training, and have taken the same courses, with a few exceptions; they have been doing the same kind of professional work all their lives. Each has a wife and a daughter. The main difference in environment is the fact (reported) that *L* has a rather unsympathetic wife, and his home life does not give him the companionship he needs. *I* is happily married, and his home life is ideal. Their personality traits have perhaps resulted in some environmental differences, as *I* is more socially inclined, and has more friends.

Their disease histories have been similar, both having had the same illnesses, and usually at the same time. At present *I* has heart trouble and must avoid violent exertion, and *L* has not been very well for the past year or two. It is interesting to note that *L*, the first-born, precedes *I* in reaching various stages of development; he was the first to require glasses, and the first to need false teeth; at present he seems to suffer from fatigue and absentmindedness, and exhibits symptoms of feebleness and old age far more than does *I*.

In personality they are very different, although both are sensitive, anxious to excel, modest, sympathetic, very conscientious, and persevering. They used to be very alert intellectually, but at present this is not true of *L*. A brother reports that *I* is more socially inclined, and more like their father, while *L* is more like their mother. *I* is more impulsive and quick-tempered; *L* is inclined to be solitary. An observer always feels comfortable and at home in the presence of *I*; any visitor, however welcome, finds it something of a strain to be with *L*.

The Strong Vocational Interest Test showed that they have many interests in common. In eight occupations both received scores above C. In addition to these common interests, *L* had four interests which *I* did not have, and *I* had two which *L* did not have. Their interests differ in specific ways, but the total picture is one of similarity rather than difference.

L is more self-sufficient, more extroverted, and more dominant according to results of the Bernreuter Personality Inventory. The difference in introversion was not great, but was something of a surprise, because *I* is the more socially inclined, and *L* appears to worry and daydream more. The desirability of a retest is evident.

By means of an information test it was shown that neither has much tendency to overstate, but *L* overstated more than *I*. The Masculinity-Femininity Test showed that *I* has considerably more of the mental traits of masculinity. The Watson Test of Fair-mindedness indicated that both have many more prejudices than the younger twins tested, but *L* has nearly twice as many as *I*.

The Meier-Seashore Art Judgment Test scores indicate that neither has any aptitude for art, but *I* was better than *L*.

Since the Stanford Achievement Test measures facts both must have learned (detailed information on the case makes this conclusion unavoidable), the great difference in score must mean that *L* has a gross memory defect. He was allowed to try all items in order to eliminate differences due to speed. Any one of the differences found above is sufficiently large to be significant taken alone. The general trend of results indicates that *L* has poorer powers of observation, less

speed of reaction, a poorer memory, less information, a much more limited vocabulary, and less resistance to fatigue.

Early home life and school training have been very similar, and later environments have been far more similar than one would expect, even for twins. Yet *I* is in all respects definitely superior to *L*. The best conclusion the writer is able to draw is that *L* is more rapidly aging, and has reached a rather advanced stage of (normal) senescence while *I* is still carrying on very capably. It remains for further observation to determine whether the differences have always been present to some extent, and are merely increased by the onset of old age.

Case IV. Twins D. and V.

D and *V* are the Siamese girl twins investigated by by Dr. Helen L. Koch[4]. They were fourteen years of age at the time of the examinations.* Of course they must be monozygotic, and their physical traits were very similar, although not more so than the inheritable physical characteristics of the above-described pairs. *D* is the right member of the pair, and is right-handed; *V* is left-handed. They have very similar developmental histories, but *D* menstruated one month in advance of her twin, and cut her teeth three weeks earlier. She is slightly larger than *V*.

The twins were very similar as regards results of the Downey tests, but the Kent-Rosanoff Free Association Test revealed considerable differences, *V* having over three times as many individual responses, and greatly exceeding the norms. The Pressey XO tests gave very different results for the two, indicating an emotional difference. In tests of speed of movement, in tapping and in card sorting, *D* was superior.

D was more talkative, and was consistently superior in all tests of intelligence and scholastic achievement.

In addition to the above, a lengthy series of tests of vocabulary, composition, and reading comprehension was used, and in these *D* was consistently superior. The differences in intellect and achievement were less than are found in most twins, but practically all favor *D* For details, see the original article.

All deviations from the norms were in the minus direction. As in our Cases I and II above, there is an essential similarity of profile and of achievement level with reference to random pairs of comparable age, but there can be no doubt that one of these girls is very consistently superior to the other. This case certainly supports our contention that those differences are hard to explain in terms of environmental factors.

Summary and Discussion

Each of these four cases of identical twins reared together exhibits a consistent intra-pair difference in ability as measured by tests of intellect and achievement. The high reliability of such long batteries of tests, and the regularity with which the results point in one direction justify the conclusion

TABLE III. Results of Tests of Intellect and Achievement—Case III.

	I's Score	L's Score
Vocabulary Tests		
Test A	108	69
Test B	100	86
Stanford Achievement Test		
Total Score	1174.5	913
Educational Age	18-6	14-1
Willoughby battery of 11 tests		
Total Score	346	138

*These twins are illustrated in this JOURNAL for July, 1931, Pp. 202 and 203.

that the differences are statistically significant.

In Cases I and IV the twins are adolescents, whose environments have always been unusually similar. In Case III the twins were much more different than in Case II, although the similarities of environment were greater in the former case. In Case II the difference in ability is in favor of the twin with the less favorable environment.

The data suggest that in some cases at least, identical twins may show a small but consistent congenital difference in mental ability. Certainly in these four cases stable differences have been found, which are difficult to explain on the basis of tangible factors in the post-natal environment. Since differences in physical traits such as size, weight, and strength seem to exist in some pairs of identical twins from the time of birth, it seems reasonable to assume the same may be true of the mental difference here reported.

Case I represents the first pair of adolescent twins on whom complete data were obtained; Case II and Case III are the first two pairs of adult twins studied. There are very few studies of identical twins reared together, and Case IV, reported by Dr. Koch, seems to be the only one furnishing the data necessary for comparison with our results. The writer does not believe that such situations are prevalent for identical twins, but all the results do support the hypothesis that in some cases the differences found, though small, are not random fluctuations.

The assumption of slightly unequal mental endowment in identical twins may be reasonable in view of the demonstrable fact of hereditary bilateral asymmetry in physical traits. Just as the right and left sides of a person's face may differ, so may the right and left sides of his brain. If the right and left cerebral hemispheres differ in functional capacity in normal cases, so may the brains of identical twins differ in functional capacity.

A word of caution is necessary here. These results do not in any way contradict the well-accepted conclusion that monozygotic twins are extremely similar in physical, mental, and social traits. The differences found are much smaller than one would find for representative pairs of siblings or like-sex fraternal twins. In an intensive study it has been possible to observe the slight differences between twins, who, when compared with siblings in general, display an essential similarity of mental make-up. It is significant that in these cases where the twins reared together do differ consistently, the differences are not always in line with such environmental differences as are ordinarily considered to be important factors in determining mental development. At least, a consistent explanation in terms of such environmental factors is elusive. No final conclusions can be stated at this time, but it is felt that an interesting problem has been ap-

TABLE IV. Results of Tests of Intellect and Achievement—Case IV.

	D's Score	V's Score
Army Alpha, form 8, total score	46	40
Terman Group Test, Form A, total score	59	42
Army Beta, total score	58.66	53.17
Performance Tests, total scores		
Ship Test (Glueck)	22	20
Feature Profile (Knox & Kempf)	7	7
Mannikin Test (Pintner)	7	5
Cube Imitation (Knox Pintner)	5	5
Courtis Arithmetic Tests, Series B, Form 1		
Total score, number attempted	15	11
Total score, number right	8	1

proached, and further study of these cases and others like them may reveal facts of fundamental importance bearing on the nature-nurture controversy, and on twin resemblance in particular.

AUTHOR'S NOTE: Since this article was written, Dr. Newman has discovered three or four more cases of identical twins reared apart, and a report of one such case is published in the preceding number of this JOURNAL. The new data reported in the present paper undoubtedly have some bearing on the same general questions, and the reader will wish to consult Dr. Newman's report for a more complete account of the findings regarding identical twins reared apart, and for information concerning the last case studied.

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Appendix

Physical Similarities of the Twins

Case I. B.E. and L.E.

The twins report that they are mistaken for each other very frequently by relatives, teachers, and friends, and sometimes by their father. Teachers report that they cannot tell the boys apart, in some instances, and others could not until they had seen them every day for three weeks. Their mother reports that she cannot tell they apart at a distance, and sometimes mistakes them when nearby if their backs are turned. She considers their facial expressions different, and notices that *L* has a somewhat fatter face. The examiner was unable to note these differences.

Disease History

Both have had measles and mumps, but neither has had whoping cough, scarlet fever, chickenpox, or smallpox. *B* had pneumonia (age 5 years) but *L* did not. Since that time *L* has been a bit stronger. Both are in good health, and are big, strong boys for their age (fourteen years).

Physical Measurements

	B.E.	*L.E.*
Height, inches	64.8	65.1
Weight, lbs.	114.	119.
Head length, Cm.	19.1	19.4
Head width, Cm.	15.0	14.1
Hair color	light brown	light brown
Hair color	N	N
Eye color	gray	gray

The letter designation of hair color was obtained by use of the Haarfarbentafel of Fischer and Saller. The letters of the alphabet in order indicate increasingly darker shades. This furnishes a more exact description than the mere naming of the color.

Reversal of Asymmetry

L is right-handed, and *B* reports that he is naturally left-handed, although he has learned to do most things with his right, such as writing or throwing a ball. He uses his left in eating, for example in using a soup-spoon. Results with a hand dynamometer indicate that *B*'s two hands are more nearly equal in strength than those of most right-handed persons. The results of the tapping tests are not definitely in agreement with the report on handedness. Data are furnished in the table below.

Tests of Handedness

		B.E.	*L.E.*
Strength of grip, in kilograms. Average of 8 trials with a hand dynamometer.....	R.	38.	43.5
	L.	36.5	39.
Speed of tapping. No. of taps in 10 seconds. Average of 7 trials.....	R.	62.1	58.4
	L.	53.6	45.1

Examination was made for position and direction of whorl of hair, as an additional indication of reversal of asymmetry. *B.E.* has a counter-clockwise whorl slightly to the left side; *L.E.* has a clockwise whorl slightly to the right side.

Fingerprints

The prints of all the twins are furnished in order that the reader may see the similarities and differences which exist. The police classification furnishes a rough indication of degree of similarity, and analysis by the methods outlined by Bonnevie[1] gives supplementary evidence. Although the similarities of finger prints of twins do not extend to the minute details, there is close resemblance here in type and shape of pattern and in quantitative measures based on ridge-counting. The similarity is much greater for twins *B.E.* and *L.E.* than is usual even for identical twins.

Other Evidences of Similarity

Both twins have a decayed upper and lower molar on both sides of the jaw. The teeth of both are crooked. Two of *B*'s front teeth show more decay than do *L*'s.

The following data on developmental phenomena were reported by the mother:

	B.E.	*L.E.*
Weight at birth, lbs.	8½	8
Age first walked (approx.)	1 yr.	1 yr.
First teeth (approx. age)	10 mo.	10 mo.
Age entered school	6 yrs.	6 yrs.
Voice changed (approx. age)	12 th yr.	12th yr. (about 3 mo. later than *B.*)

Since the mother has to rely on memory for these details, perhaps they are not extremely accurate, hence the writer does not wish to exaggerate their importance. However, the mother of twins would naturally notice *differences* in development if they occurred. In this case she reports that progress in locomation and in speech development proceeded at the same rate, and that there were no differences in age of cutting teeth. *B*'s voice changed about three months earlier than *L*'s. At present the voices of the twins seem alike to the examiner, although the mother considers *B*'s slightly more high-pitched.

The ears of the twins are very similar, both having a free lobe. They are like the father's in this respect. Their older brother's ears are much different, and like the mother's have no free lobe.

Similarity in body build is indicated by the fact that they can wear each other's clothes, including shoes, hats, coats, and trousers. Each reports that the other's clothes fit him very well.

Case II. Twins T.C. and D.C.

T.C. and *D.C.* are twin sisters 38 years of age. At present they seem superficially different in appearance, because *D* is tanned from exposure to the sun, and because she is much stouter. There is great similarity of body build, and both are inclined to be stout, but not to the same degree. *D.* has always been slightly larger and stronger.

When they were young, teachers, relatives, and close friends had great difficulty in telling them apart, up to the age of about 20 years. They report that both their parents sometimes mistook one for the other, the father more frequently. The examiner studied carefully pictures of the twins taken at ages 3, 4, and 16, and all these photographs revealed a striking similarity of the two girls.

Their disease histories as reported were very similar: both had measles, mumps, and whooping cough, at the same time. They did not have any of the other diseases of children.

Physical Measurements (at present)

	T.C.	*D.C.*
Height, in inches	63.2	63.5
Weight (reported)	160-165	190-195
Hair color	medium brown	medium brown
Hair color	P or Q	P or Q
Eye color	blue	blue
Head length, Cm.	18.2	18.7
Head width, Cm.	14.3	14.7

Both have a naturally light complexion, but *D*'s is more tanned as she spends more time outdoors. The designation of hair color by means of the Haarfarbentafel of Fischer and Saller was difficult, for their hair is somewhat faded, and gives the appearance of not being exactly like any of the samples. No clear indication of a whorl was discovered.

Reversal of Asymmetry

Both twins are right-handed, and report that neither has ever shown any tendency toward left-handedness. Two tests of speed of tapping and strength of grip were taken, with the results as indicated below.

	T.C.		*D.C.*	
Grip, in Kilograms	First	Second	First	Second
Right hand	22	25	35	38
Left hand	19	20	27	33
Speed of tapping. Taps in ten seconds				
Right hand	70	75	61	68
Left hand	63	63	61	63

The similarity of speed of tapping for her two hands may perhaps be an indication that *D* has a slight tendency toward being ambidextrous, but such a conclusion would not be warranted without more extensive study.

Examination of the finger prints indicates same-sided symmetry rather than mirror-imaging.

Other Evidences of Similarity

By inspection their teeth are similar. Both report they have poor teeth, and find it necessary to have considerable dental work done.

Although they are larger than average, they both have small shapely hands. The similarity in this respect is at once noticeable.

Their features are very similar. Both have round faces, small noses, and short upper lips. Both have freckles.

Case III. Twins I.R. and L.R.

When the twins were young, teachers, relatives, and friends had great difficulty in telling them apart. Their father sometimes mistook them, but their mother never did. Photographs taken at various ages were studied carefully by the examiner, and the indication was of great similarity. However, there are some slight differences in appearance, which give the impression of mirror-imaging.

At the present time it is not difficult to tell them apart, as *I* is much more active, and more alert intellectually. *L* is somewhat florid, while *I* is rather pale.

Physical Measurements

Height, inches	63.6	63.9
Weight, lbs.	143.5	146.
Head length, Cm.	19.3	19.8
Head width, Cm.	15.9	15.4
Hair color	white	white
Eye color	blue	blue

Reversal of Asymmetry

I is entirely right-handed, but *L* is left-handed in some things, using the left to hold a soup-spoon, etc., but the right for throwing a ball. Both use the right hand for writing.

Strength of Grip: Average of five trials with the hand dynamometer

Strength in kilograms:	*I.R.*	*L.R.*
Right hand	38.4	23.8
Left hand	32.2	16.2

Because of *L*'s incoordination, tests of speed of tapping were not attempted. These results serve to show quite clearly the differences between the two, but are probably not very useful as indications of right- or left-handedness.

Because of baldness (they are over 60 years of age) no data concerning whorl of hair are obtainable.

The indication from study of the finger prints is that of same-sided symmetry.

Other Evidences of Similarity

It is reported by an older brother that the twins learned to walk and talk at the same time, and have always been much alike in development. They are much smaller than their other brothers.

Neither had any trouble with his teeth until past middle age. Both lost their teeth suddenly, supposedly from the effects of pyorrhea. *L* preceded *I* by a few years in this respect.

About 30 years ago *L* found it necessary to wear glasses. A few years later *I* also had to get glasses.

The ears of the twins are similar in appearance, and all four ears have free lobes.

The twins can wear each other's clothes, including shoes, hats, gloves, coats, and trousers. These fit well, except that *L*'s shoes and hats are a trifle larger.

Unsolved Problems of Evolution

THE PROBLEMS OF EVOLUTION, *by* A. W. Lindsey, Professor of Zoology at Dennison University. Pp. 236. Price $2.00. The Macmillan Co., New York. 1931.

WISELY has this title been chosen, for the book presents a series of evolutionary problems and leaves them still as problems—unsolved, except perhaps for the author's reserved opinion on what the answer might turn out to be eventually. His analysis is scholarly although at times somewhat dry.

Recent advances in evolutionary science or philosophy are so fragmentary and inconclusive that it is questionable if anyone is ready to do more than Lindsey has done in merely discussing the existing state of affairs. He has incorporated some of the newer genetic aspects but unfortunately has not included the recent, brilliant contributions by R. A. Fisher as summarized in the "Genetical Theory of Natural Selection."

Lindsey's own interpretation of evolutionary processes is neither Darwinian, Lamarckian nor mutational. He attempts a correlation of the three that savors, however, of Lamarckism:

The modification of the heritage may be sought in the variable environmental conditions which give it the opportunity for variable expression of its inherent properties. Acquired characters are cytoplasmic in their expression, but so are inherited characters. Cytoplasm is the material of construction in which all characters are wrought.

Two interpretations of the activity of the chromosomes in the development of acquired characters are possible. We may conclude that they always exert the same influence and that the cytoplasmic result is cumulative, or that the chromosomes also undergo a cumulative change which is responsible for the condition of the cytoplasm, that the ultimate expression of the acquired character is the result of an actual increase through use of the functional capacity of the genes involved in its production, and since the chromosomes must grow and reproduce like all living things, we cannot avoid the possibility that, in spite of their remoteness, a residuum of influence may reach them from the surrounding body.

All this seems like common sense, but like the older, historical common sense of Lamarck and of Darwin, it should not be, as it was and still is, so infernally refractory to experimental proof.

Lindsey's book is not particularly adapted to the lay reader but should be extremely useful to advanced students in biology.

E. W. Lindstrom.

SOME DIOECIOUS PLANTS

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A DIOECIOUS COMPOSITE

Figure 6

It is not generally realized that the Canada thistle (*Cirsium arvense*) is a dioecious plant. In this picture a patch of female thistles is shown (with the white heads) and a patch of male thistles in the background, without the white heads. The fact that the plants occur in patches all of the same sex probably accounts for the mistaken idea that the Canada thistle does not produce seeds. It is amply fertile when both male and female plants are present.

IT appears that the early Assyrians and Egyptians many centuries ago knew that there were both male and female trees of the date palm. Their knowledge of sex in plants, however, was not extended to other plants nor known to botanists, and it was not until the experiments of Camerarius in the last of the 17th Century that sex in plants was demonstrated for the benefit of following generations. Our knowledge of this important phase of plant development dates back to his work.

Even today there are still differences of opinion in regard to inheritance of sex in plants. One group is of the opinion that sex is entirely Mendelian and governed by genes (factors) in the same way that other morphological characters are inherited. The other group believes that sex is due to physiological causes acted on by the environment. Perhaps both are right, at least in part.

At any rate, the dioecious plants; that is, plants which bear staminate and pistillate flowers on different individuals, furnish us a better understanding of sex in plants than any other of the members of this kingdom.

The number of plant genera which are dioecious is surprisingly large. Illustrations of this condition in plants

SEX REVERSAL IN HOPS

Figure 7

The female flowers are the cone-like structures on the central branch near the tip. The finely branched male flowers are on the branch at the right. The branch at the left is hermaphrodite, having both male and female flowers. This is a plant of male hops, which has, for reasons not clearly understood, produced some female flowers. A study of sex phenomena in dioecious plants is valuable in throwing light on the physiology of sex, and is of direct practical importance to breeders of economic plants.

usually include two or three common examples, such as the date palm, hemp, and hops. There are many other plants, however, which have this condition.

Most of the dioecious types are found in the lower groups of flowering plants, such as the willows, box elders, ashes, and similar trees. Others occur in the hemp, hop, mulberry, buffalo grass, some cucurbits, poplars, nettles, some salt bushes, osage orange, mulberry and asparagus.

One of the very highest groups of flowering plants contains a dioecious genus. This plant is the well known Canada thistle, *Cirsium arvense,* in the compositae (see Figure 6). Most of these are dicotyledonous plants, and most of the dioecious plants are found in this division. That they are not limited to this division is indicated by the dioecious condition of the date palm, which is a monocotyledonous plant.

In almost every case there are exceptions to the dioecious condition and some plants which are monoecious are invariably found. In some genera this variation is greater than in others. Hops, for example, exhibit both dioecious and monoecious plants, but the latter are rather rare, and occur as a rule on plants which were formerly males; that is, a male plant will exhibit male flowers and then show some female flowers, and finally perhaps exhibit the male condition again. Growers often make the statement that male plants will change to females. This was rather hard to believe until some of the recent work had shown that plants of hemp, for example, could be reversed in sex by the proper environmental conditions.

Recent work by Schaffner[2] shows that by planting hemp, *Cannabis sativa,* at different months of the year in the greenhouse one can make the plants reverse their sex. His work has a fundamental application to this whole problem of sex, as well as a practical application where certain sexes of plants are desired. Similar reversals in male hops have been noted by the writer (see Figure 7).

The difference in sex of plants of Canada thistle has been puzzling to many, and the literature is replete with misinformation in regard to this plant. Detmers[1] made a survey of the thistles in Ohio. She states that the two types of heads and florets were found. The staminate ones were oblong, while the carpellate heads were ovoid or flask-shaped. Contrary to the opinion of many other writers, she found that the plants are dioecious, and that a patch of thistles may be either staminate or carpellate. She is of the opinion that staminate and carpellate plants must be near enough to insure pollination if seeds are to be formed. This readily accounts for the mistaken idea in some sections that Canada thistles do not produce seed.

Some of the newer conceptions in animal breeding have been taken from the work with plants, because larger numbers could be worked with and results obtained at a far smaller cost and in a shorter time. It is surprising that little of this work has been done with dioecious plants. It seems that much of the work would be more applicable to animal breeding if plants of this type were used. The writer is just beginning experiments in hop breeding work. This dioecious plant is exhibiting some interesting things in its seedlings. It is hoped that in addition to the development of varieties of economic value that some light may be shed on the development of the different sexes on particular plants.

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Photograph from H. E. Zimmerman

NO RACE SUICIDE HERE

Figure 8

A French-Canadian family of twenty-one children, including five sets of twins. In the days when storks rampant might have been carried on the escutcheon of any New England family, such an amazing collection of children as this would hardly have qualified as "news." Today, thanks to the prevalent one- and two-child families, an obituary of the New England Puritans is in order. While a levelling off of population growth curves is not necessarily a catastrophe, it may be such if the large families (*and there still are large families*) are being produced principally by the less gifted components of the population. The battle of births and deaths goes on always, and when it comes time to write racial and class obituaries it is likely to be almost too late to discuss to any purpose questions of racial betterment.

▼

THIS WORD "FAMILY"

The announcement of an article on "Does Family Size Run in Families?" elicited the comment from a correspondent that such a double-barrelled use of a word by a publication committed to definitions of genetic terms deserved the extreme penalty. It was pointed out that nearly a score of distinct meanings of "family" were in current use, and the word was nominated for inclusion in our Glossary. Such formal recognition of the word's parlous state is declined however, because the entire English language would soon be crowding our third cover were the precedent admitted. After trying out several other concatenations of words we are letting the title remain as Dr. Huestis originally submitted it. The other words available had almost as many definitions as "family" and none seemed an improvement. "Sibling" is "out," since its recent exposé in William Lyon Phelp's column in *Scribner's Magazine:* "inheritance" has legal connetations entirely misleading; "progeny" might be forced to serve, but does not really fit.

It is a curious fact that in spite of the multiplicity of meanings which "family" may convey, it is nevertheless true that this title probably will not mislead many people. This instance raises interesting questions in the problem, or problems, of explaining what words mean, and of the relative merit of priority and of use in their definition. To these questions there seems to be no satisfactory answer.

THE NEW ENGLAND PURITANS:

An Obituary

J. J. SPENGLER
University of Arizona

The people (of New England) are purer English blood; less mixed with Scotch, Irish, Dutch, French, Danish, Swedish, etc., than any other; and descended from Englishmen, too, who left Europe in purer times than the present, and less tainted with corruption than those they left behind them.—JOHN ADAMS.

WHEN these words were penned by John Adams more than a century ago the stork was as truly suited as the pine tree to grace the standards of New England. Women often were grandmothers before they had rounded out their fortieth year. Frequently, under the same roof, one found a mother suckling a ninth born and a daughter suckling a first born. The average number of births per family, according to Benjamin Franklin, was about eight, a figure practically substantiated by the recent researches of A. J. Lotka. From the loins of the New Englanders sprang a large part of the population which gradually flowed westward into the vast unsettled area lying east of the Mississippi.

The nineteenth century, however, witnessed a complete reversal in those folkways of the New Englanders which concerned procreation. Family size had already begun to shrink in certain classes of the population when President Madison remarked, less than a decade after the War of 1812, that "New England . . . . has continued to increase" despite the lack of immigrants and a steady efflux "to other parts of the Union." The civilization which developed in nineteenth century New England and which swept steadily westward, gradually stifled the procreative impulse until today the native women of New England are bearing too few children to replace themselves. Fertility among the foreign born women has declined in a similar fashion and will soon be on a parity with that of the natives.

Evidence of the decline in fertility in New England is to be found in genealogical records and in the birth returns published for various parts of New England. Three years after the Civil War, Dr. Nathen Allen of Lowell, Massachusetts, cited genealogical records to show that the average number of children per family had fallen from eight to ten in the seventeenth century to three at the time of the Civil War. F. S. Crum gives these averages for children per wife in New England and the Middle Atlantic States: before 1700, 7.37; 1700-49, 6.83; 1750-99, 6.43; 1800-49, 4.94; 1850-69, 3.47; 1870-79, 2.77. Other genealogical records reveal a similar trend. Among college graduates in the nineteenth century lower averages obtained. In so far as one can generalize from the genealogical records it appears that the decline became marked during and after the third decade of the nineteenth century.

A better picture of the general trend is to be found in the birth returns for the several New England States and for several of the cities in New England. These we shall consider in order. The average annual number of births per 1,000 native women, aged 15 to 49 years, is given in Table I. Corresponding averages for foreign born women are given in Table II.

I

The rates given in Table I reveal no definite downward trend in the fertility of the native women between the period of the Civil War and the period immediately following the World War. In Massachusetts, however, the pre-Civil War rate of 76 was never touched after

1860. In every state we find higher rates for every period since 1911-1915 than were observed in that period. To what extent this increase since 1911-15 is a true increase and to what extent it is the result of a more complete registration of births it is impossible to say. Improvement in birth registration does account, in part, for the failure of the fertility rate to decrease after 1865 and for the increase since 1910. In every state the rates were higher in 1921-25 than in 1919-20. Since 1921-25, however, native fertility has decreased in every state. This decrease is apparently the result of an increase in family limitation and not the result of a change in age composition. Comparison of the age composition of the native female population living in New England in 1920 with that living there in 1930 indicates that in 1930 the total number of births to native mothers ought to exceed the number registered in 1919-20

TABLE I. The Average Annual Number of Births Per Each 1,000 Native Females aged 15 to 45*

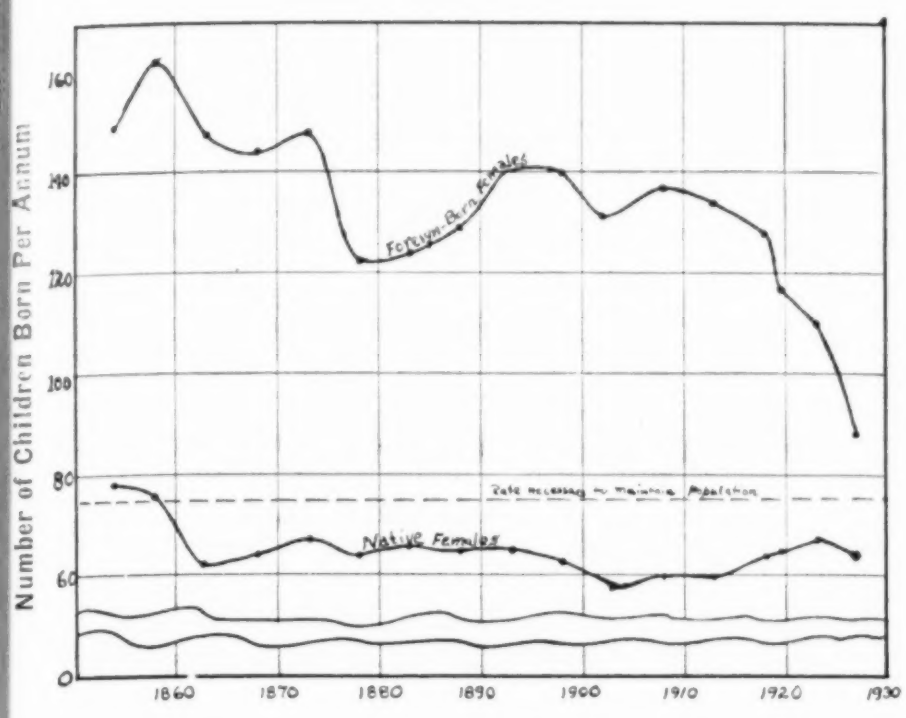
Years	Maine	New Hampshire	Vermont	Massachusetts	Rhode Island	Connecticut	New England
1853-55				78			
1856-60				76	65[a]		
1861-65				62	56		
1866-70				64	64		
1871-75				67	67		
1876-80				64	67	63[b]	
1881-85		53[c]		66	63	65	
1886-90		53		65	60	64	
1891-95	70[d]	57		65	61	64	65
1896-1900	69	57	76[e]	63	61	60	65
1901-05	69	57	76	58	59	57	64
1906-10	75	62	77	60	59	55	62
1911-15	75	65	77	60	59	56	62
1916-20	79	71	80	64	65	65	67
1919-20	81	73	79	65	64	65	68
1921-25	86	78	85	67	69	63	70
1926-28	81	72	80	64	66	60	67

* Rates for 1919-20, 1921-25, 1926-28 are for white population only; Rates for 1853-1920 are for colored and white. As colored are relatively few in number exclusion or inclusion does not affect rates. (a) 1857-60; (b) 1878-80; (c) 1884-85; (d) 1892-95; (e) 1900.

TABLE II. The average Annual Number of Births Per Each 1,000 Foreign-born Females, Aged 15 to 49†

Years	Maine	New Hampshire	Vermont	Massachusetts	Rhode Island	Connecticut	New England
1853-55				149			
1856-60				162	134		
1861-65				147	125		
1866-70				144	126		
1871-75				148	117		
1876-80				122	108	127	
1881-85		104		123	108	129	
1886-90		108		129	113	123	
1891-95	142	126		141	129	135	138
1896-1900	142	131	127	140	138	133	138
1901-05	137	127	147	131	134	135	133
1906-10	138	132	143	137	133	153	139
1911-15	122	121	131	134	125	161	137
1916-20	116	118	127	128	128	166	134
1919-20	115	115	117	117	127	143	125
1921-25	128	112	117	110	112	119	113
1926-28	110	90	105	88	92	90	91

† See footnote under Table I.



TRENDS IN BIRTH RATIOS

Figure 9

The average annual number of births for each 1,000 females aged 15 to 45 in the population of Massachusetts—native and foreign born. The surprising decline in the foreign-born ratio and the slight increase in the native ratio means that at the present time the future population of Massachusetts is being determined not by relative increases, but by relative rates of dying out! This chart is based on the data in Table I.

by 17 per cent. When the 1930 figures are made available, however, they will exceed the 1919-20 figures by only about 13 per cent. It is apparent, therefore, that fertility has declined among the native women since 1919-20, for changes in martial composition will probably prove inadequate to account for the lessened frequency of births.

The rates for the foreign-born women reveal that among them fertility has declined. In every state, for which data are given, the rates for the foreign-born declined after the Civil War until the closing decade of the nineteenth century when the foreign rate increased in every state but Maine. This increase is apparently the result of two factors: (a) a change in the ethnic composition of the foreign-born and (b) an improvement in the marital composition of the foreign-born. After 1890 the immigrant population was recruited in increasing proportion from Southern and Eastern Europe (Italians, Russians, Poles, etc.) among whom larger families and a greater frequency of births were found than among the Irish, British, Germans, etc. Between 1890 and 1920, of the foreign-born women aged 15 to 44 years, the percentage who were married increased from 53.8 per cent to 72.2 per cent. This improvement in marital composition is in part a result of the changed ethnic composition of the foreign-born population for, since the ratio of males to females was relatively higher among the immigrants from Southern and Eastern Europe the frequency of marriage among the females was higher than among the immigrants from Northern and Western Europe. Since 1915 foreign fertility has declined in four of the New England states and since 1920 the decline is observed in each state. In 1926-28 foreign fertility in New England was 34 per cent below the 1911-15 level and 27 per cent below the 1919-20 level. Part of this decline, only, is attributable to an increasing unfavorableness in age composition. Comparison of the age composition of the foreign females in 1920 and 1930 indicates that in the latter year they should have borne one fifth less children than in 1919-20. In 1928 they bore 38 per cent less and in 1930 nearly fifty per cent less. Foreign fertility therefore appears to be falling off sharply.

Comparison of the native and foreign rates reveals that maternity has always been more frequent among the foreign-born than among the native-born women. Until recently the foreign rate has often been at least twice as high as the native rate. Since the foreign rate is shrinking more rapidly than the native rate the two rates are rapidly approaching each other in magnitude. Thirty-five years ago the foreign rate in New England exceeded the native rate by 116 per cent; in 1919-20 this superiority was 84 per cent; in

1926-28 only 36 per cent. Much of this superiority is due to the more favorable marital composition of the foreign-born, just as much of the superiority of the fertility of natives living in Maine, New Hampshire, and Vermont is due to the more favorable marital composition. In light of the fact that the marital composition of the foreign born is no longer improving and in light of the fact that the practice of birth restriction is now dominant in the regions from which most of the immigrants come, the fertility of the shrinking immigrant population will soon approximate that of the natives.

II

In Providence, Rhode Island, we observe a trend similar to that observed in the New England states. The observed rates for native- and for foreign-born women have been as shown in Table III, since 1891.

The rates in Table III indicate that between 1891 and 1929 fertility for all women, 15 to 44, declined 18 per cent among the natives and 39 per cent among the foreign-born. Fertility among the native married women declined 8 per cent while that among the foreign-born declined 26 per cent. The excess of foreign over the native rate for all women fell from 124 per cent in 1891 to 67 per cent in 1928-29. Among the married women the superiority of the foreign-born dropped from 76 per cent in 1891 to 42 per cent in 1916-20. In short among all women and among the married women fertility has declined more rapidly among the native than among the foreign-born and the levels of fertility in the two groups are approaching each other.

If the fertility rates for native and foreign-born married women are corrected for the approximate number of births which escaped registration we find rates of 206 and 324 in 1874-76 and 177 and 317 in 1894-96. Between 1875 and 1895, accordingly, fertility among the native married women declined 14 per cent whereas that among the foreign-born declined only two per cent. The shrinkage since 1875 has been 25 per cent in the native and 32 per cent in the foreign married fertility. Convergence of native and foreign married fertility thus appears to be a twentieth century phenomenon.

Comparison of the fertility of Boston with that of Providence reveals a somewhat similar trend. In 1845[2] the native and foreign birth rates in Boston were 22 and 61 compared to Providence rates of 20 and 64 in 1856. Newsholme and Stevenson give as the corrected legitimate rates, (not adjusted for unregistered births), for native and foreign-born in 1875 in Providence, 16-10 and 27.79. In 1900 these were: Boston 18.2 and 31.1; Providence 16.00 and 31.1. In 1845 the births per 1,000 married women, aged 15 to 44 years, approximated those of Providence in 1875, being 199 among the native and 290 among the foreign-born married women. In 1919-20 the corresponding rates were 204 for the natives and 206 for the foreign-born married women. Assuming that all births were enumerated in Boston in 1845 and that in 1919-20 but few births were registered in Boston to non-resident mothers, it appears that in 1919-20 fertility among the native married women was nearly three per cent higher than in 1845 whereas fertility had declined 29 per cent among the foreign married. If we compare the age compositions of 1845 and 1920 we find that in 1920 native married women should have borne 318 per cent more children than in 1845 whereas they bore 358 per cent more. The foreign-born married should have borne 614 per cent more whereas they bore 491 per cent more than in 1845. In light of these figures the true fertility of the natives increased about 10 per cent while that of the foreign-born decreased 17 per cent between 1845 and 1920. If we al-

low for births to non-resident mothers,* however, the shrinkage in the fertility of native and foreign women in Boston since 1845 probably approximates the corresponding shrinkage in Providence since 1875.

What the shrinkage was in native fertility[3] prior to 1850 we do not know. In Rhode Island in 1776 the ratio of white children 16 years old or less to females above 16 was 1,636 per 1,000. In 1920 in Rhode Island the corresponding ratio for natives was 619; for foreign-born, 1,386; for the entire state, 928. The reduction in this ratio indicates a marked decline in fertility, especially among the natives, even when allowance is made for greater longevity in 1920.

In Boston, according to Lemuel Shattuck,[2] the birth rate was close to 50 per 1,000 during the half century preceding the American Revolution. This estimate is based on an observed rate of 30 to 34 christenings per 1,000 inhabitants in Boston between 1725 and 1754. In 1783 Edward Augustus Holyoke[4] presented a bill of mortality for Salem for the years 1782 and 1783. If we accept his population estimate of 9,000 we get birth rates of 35 and 43 for 1782 and 1783 and a death rate of 19 each year. Infant mortality rates were 114 and 99. As Holyoke's bill is only "as compleat as can be expected" in respect to births and as by no means all children were christened in Boston after 1700, it is probable that the crude birth rate ranged between 40 and 50 per 1,000 in the eighteenth century. In other words in the eighteenth century the crude birth rate was more than twice as high as that observed among the Boston natives in 1845 and at least three times as high as that observed in Boston in 1920, allowance being made for births to non-resident mothers.

III

Have the natives of New England been replacing themselves or have they been dying out as was several times contended in the latter part of the last century? A direct answer is impossible inasmuch as the necessary information is not available. That it is prob-

TABLE III. The Average Annual Number of Births Per 1,000 Women, Aged 15 to 44, and Per 1,000 Married Women Aged 15 to 44 Years, by Nativity, In Providence†

Year	Births per 1,000 Women, 15 - 44		Births per 1,000 Married Women, 15 - 44	
	Native	Foreign	Native	Foreign
1891	71	159	169	298
1894-96	64	158	158	285
1899-1901	57	148	140	256
1904-06	58	149	-----	-----
1909-11	57	147	138	236
1916-20	82	157	155	220
1924-26	69-84	122	-----	-----
1928-29	58	97	-----	-----

† An increasing number of births, not classified by nativity, are to non-resident mothers. Rates for all women 1916-20, are not adjusted therefor; rates for native married women, 1916-20, are reduced one tenth; foreigns, one twentieth. Rates for native women, 1924-26, are reduced one fifth to one seventh; foreign, one seventh. In 1928-29 native rates are reduced three tenths; foreign, one seventh.

* That fertility should be higher among the native married women in 1919-20 than in 1845 is unbelievable despite the fact that a larger per cent of the natives were of foreign parentage in 1920 than in 1845. Births to mothers who came to Boston for delivery in 1919-20, or an incomplete enumeration of births in 1845, must explain this apparent increase in real fertility. Children of white maternity, under 5 years of age, numbered 69,573 in Boston in 1920. These represent the survivors of about 76,500 births, giving an annual average for 1916-20 of 15,300 births, of white maternity compared with a reported annual average of 18,673 in 1919-20. If 6,000 of these are births to native white mothers we must reduce our 1919-20 rate for married women by about 30 per cent to 143. This rate would indicate a decline of about one fourth in the fertility rate of native married women of Boston between 1845 and 1920.

able that they have been dying out is easily demonstrated, however.[5] Assuming that every woman born reaches the age of 50 and thus completes 35 years of childbearing, 1,000 women could replace themselves if, as a group, they averaged 28.6 female births per year for 35 years (1,000 ÷ 35 = 28.6). But in bearing 28.6 females per year they would bear about 59 children per annum, for of each 205 births only 100 are females. In short if every woman completed the fiftieth year a fertility rate of 59 births per 1,000 women aged 15 to 49 years would approximately replace the population. In proportion as women do not reach the age of 50 this required replacement rate of 59 must be increased. In 1870, in light of the most favorable mortality conditions of Europe, this rate needed to be about 86; in 1890, about 82; in 1910 about 75. If we compare the observed rates given in Table I with these required rates it is apparent that in Massachusetts, Rhode Island, Connecticut, and possibly in New Hampshire the natives have been dying out since the time of the Civil War, or since rates are available. Such appears to have been true also of the natives who lived in Providence, Rhode Island, and who in light of comparison with European rates, maintained a level of fertility in the last three decades of the nineteenth century as low as that in any European city with the possible exception of Paris.

Present data and methods permit a more careful answer to the question as to whether or not the natives of New England are dying out. P. K. Whelpton[6] has shown that in 1920 the native whites of Massachusetts and Connecticut were still dying out and that in 1928 the entire white population of these two states was dying out.

Thompson's[7] recent study of the 1920 census reveals a 15 per cent deficit for New England in 1920, this deficit being greatest in cities of 100,000 and over and smallest in cities of 10,000 to 25,000. Only in the rural areas and in Maine and Vermont is there natural increase in the native population of New England. Deficits of 25 per cent are found in Massachusetts and Rhode Island; in Connecticut, 20 per cent; in New Hampshire, 10 per cent. A greater deficit (20 per cent) is found in the Pacific Coast Area than in New England as a whole. In the Middle Atlantic States a deficit of 10 per cent is found. In other sections some natural increase is observable. However, when the complete data of the 1930 census are available, it will be apparent that in the United States as a whole the population no longer shows a true rate of increase.

In summary we may say that shortly after the Civil War fertility among the New England native declined to a level insufficient to maintain the population. Other parts of the United States to which the culture of New England has spread are now marked by a similar birth strike even as are European countries with a culture similar to that found in New England. Western Civilization with its marked inequalities in income and its emphasis upon material achievement is rapidly destroying the will to procreate.

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3. *Census of Rhode Island, 1776,* edited by John Bartlett, 1858.

4. *Memoirs of the American Academy of Arts and Sciences,* 1783, 546-550.

5. For more careful discussion see the writer's article in the *Quarterly Journal of Economics,* August, 1930; also Kuczynski, R.R., "Fertility and Reproduction," Brookings Institution, Washington, 1931.

6. See *American Journal of Sociology,* May, 1930, p. 872; *Journal of American Statistical Association,* September, 1929, p. 238.

7. See "Ratio of Children to Women—1920," Census Monograph XI, 1931.

DOES FAMILY SIZE RUN IN FAMILIES?

R. R. Huestis and Aline Maxwell

University of Oregon

MILDLY astonished, for the most part, that their affairs should be an object of scientific enquiry, some seven hundred of our university students filled out questionnaire blanks upon the number of children born in their own and in their parent's families. The blanks were sent to their parents' homes to be checked and more than ninety per cent were returned to us. This commendable demonstration of parental interest, combined with the evidence of care taken in the filling out and checking of the blanks, gives us a considerable measure of confidence in the reliability of the figures with which we were presented, a confidence we hope we can establish also in the minds of our readers. Certain particulars contained in the blanks have been analysed and reported upon elsewhere.[5] The present study, which includes a few data which arrived too late for inclusion in our previous report, was arranged to test the truth of a supposition that is widely current among eugenicists.

Depopulation Dangers

Let us begin a brief outline of this with the platitude that the general decline in the birth-rate has been an outstanding sociological phenomenon of the last three-quarters of a century. There are no very complete studies of the amount of complete or relative organic sterility among human beings. However, certain aspects of their behavior are so patent that there is a general agreement, among authorities, that the increase in the knowledge and use of contraceptives will account adequately for the continued reduction in family size. It has been freely predicted, too, that as this knowledge seeps downward from its centre of origin among the illuminati, to more and more completely film the moiling masses of the unlettered, they will become unworthy of their title proletarians, and depopulation will begin.

Indeed, Kuczynski[4] has demonstrated, seemingly beyond a doubt, that the present birth rate in northern and western Europe is inadequate to maintain the present population. Dublin and Lotka[2] have shown, in a similar study of the exuberantly growing United States, that the birth rate little more than suffices for replacement. The paradox of an inadequate birth-rate and present growth is readily explained by the present age grouping. Due to the previous very high birth rate, in the population in question, there is now a large number of people in their twenties and thirties, ages in which they will reproduce, if they are going to, and ages, incidentally, in which they do not often die. An abundance of people of reproductive age naturally produces a greater number of births than deaths. This wave of young adults, carrying on through more and more advanced age decennials, will soon break upon the sands of eternity, and since no waves of equal magnitude will follow, the tide of population must ebb.

What Controls Family Size?

We do not think we can be charged with arranging our own intellectual set-up, when we say that there is a common reply to such omens of depopulation. It is to the effect that there are probably genetic differences in the desire for children as well as in ability to have them, comparable to differences in height, body build and the like, but that until recently esotericism of contraceptive knowledge has forced parentage upon most

people whether it was desired or not. With a more general distribution of information, the people who lack congenital philoprogenitiveness will cease to breed. Since this will entail a relative increase of "born" parents, these latter will check depopulation by having as many children as their environment will happily allow.

This argument has been advanced, for example, by Alexander Graham Bell[1] and by R. A. Fisher.[3] It is reasonable enough to go unattacked in eugenic circles, but should the eugenicist present it to the people more inclined to explain human behavior in terms of environment he will often be confronted with the following questions:

"Don't you think parental desire can usually be satisfied by one or two children?" "Don't you think that people who grow up in a larger than average family become so conscious of its economic disadvantage that they decide not to have one of their own?" "Don't you think it is largely a matter of what the people do that you live among, and that even if a women would like another baby, she will not have one if it is going to make her appear different?" Upon taking thought, one can see that in so complex a matter as the desire for a family large enough, on the average, to maintain a given population, the premise that there are hereditary differences in love of offspring, which will fundamentally direct things, needs a searching examination. We therefore welcomed the opportunity to test the amount of resemblance in family size in two generations of families now sending students to the University of Oregon.

Family Size in Two Generations

Decisions as to family size lies oftener with the mother than with the father of the family and relative sterility is more often to be found in women than in men. We decided, therefore, that the fairest test of the matter in hand would be to find the amount of correlation present between the number of children born in the families in which students' mothers were included, and the number of children born in the families which students' mothers had. This would be essentially a test of parent-offspring correlation in family size and thus comparable with similar tests for parent-offspring correlation in height, eye color or any other known hereditary character.

A word might be said here concerning the appropriateness of the use of the population employed. Very few of our families would be uncompleted, for most students are at least 18 years of age at college entrance. We did not tabulate any blanks handed in by Asiatic students so the population is exclusively white and is, moreover, largely derived from other parts of the United States or from Northwestern Europe. We were rather surprised to discover that where denominational preference was tabulated it was largely Protestant, only 45 out of 638 mothers being listed Catholic. Finally our population is one in which pronounced reduction in family size has taken place in one generation, 638 mothers having been born in families averaging $5.53 \pm .07$ children while these mothers had families averaging $3.28 \pm .05$ children; an average reduction of over two children per family, in a generation.

The statistical data are arranged in Table I. The material was divided into a group of families listed by students as having the advantages of completely rural upbringing and a group containing their more urbanized colleagues because we knew that we had a fair number of families in the former class and that their average size was somewhat greater. Both groups, it may be seen, exhibit small positive correlation coefficients in family size. It may be noted that in the composite total population the coefficient of correlation is slightly larger than that of either group taken

separately, a situation to be expected when a correlation table includes an inhomogenious array of variables. It should be mentioned, too, that we could only assume that both generations of city and country families had been reared for the most part in that environment. We knew that the last one had, and found that city families were substantially smaller in both generations.

From an examination of our table we may conclude that family size does run in families but not to any great degree, for if we had been testing the same population for height or eye color, we could have confidently expected coefficients of three or four times the magnitude of the ones we obtained for likeness in family size.

There are probably a number of circumstances which would tend to reduce parent-offspring correlation in this latter character. We cannot separate functional from volitional sterility. People from small families in the same society, who are themselves sterile, could not appear in our table although they might be exhibiting good evidence of congenital sterility. The environment of the two generations considered was not necessarily always the same, for the parents of many of our urban students were probably reared in the country and had their own families in the city.

From a theoretical standpoint, of course, accurate determination of the inheritance of a character should be made in a constant environment. However, it is also true that, to the extent that environmental differences affect the expression of a character, hereditary differences in it become of lesser practical importance. Our conclusion in this instance, based upon data which we freely admit does not by any means dispose of the question, is that family size is a character which at present is much more affected by the environment than by congenital differences in love of children or ability to have them. Reduction in family size is, as yet, a pretty general matter.

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4. Kuczynski, R. R. 1928. The Balance of Births and Deaths.

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TABLE I. Mean number of children born in 638 Families sending children to University of Oregon

	In 118 country families	In 520 city families	In all 638 families
In which students' mothers were born (x)	6.08 ± .18	3.11 ± .05	5.53 ± .07
Which students' mothers have (y)	4.05 ± .15	5.41 ± .08	3.28 ± .05
Correlation of x and y; r=	+ .104 ± .06	+ .111 ± .03	+ .124 ± .02

WHERE ANGELS FEAR TO TREAD?

A Review

WHAT IS LIFE? *by* AUGUSTA GASKELL. Introductions by Karl T. Compton and Raymond Pearl. Pp. 324. 3 Parts, 9 Chapters. Springfield, Ohio. Charles C. Thomas. 1928.

CAN SCIENCE EXPLAIN LIFE? *by* CARL F. KRAFT. Pp. 94. Price $1.00. Lancaster, Pa. The Science Press Printing Co. 1931.

MRS. GASKELL'S book, "What is Life?", is of interest because of its contained introductions by two such eminent scientists as Karl T. Compton and Raymond Pearl. Both are careful not to state that they actually believe in Mrs. Gaskell's hypotheses, and they make various reservations and qualifications, yet both are commendatory in their general tone, and endeavor to disarm in advance, as "dogmatic," the general condemnation of the book which they evidently anticipate. According to Compton, "her discussion of atomic physics is accurate, well balanced and worth reading for its own sake . . . The book stimulates serious thought and it is to be hoped that it will contribute to the successful solution of the problem 'What is Life?'" According to Pearl, "Mrs. Gaskell's discussions of various biological problems, particularly evolution, have a refreshing novelty and shrewdness which gives them a value by no means negligible." The book is characterized by Pearl as "extremely stimulating and original." Furthermore, he says, "the present is a propitious time for the appearance of Mrs. Gaskell's original and ingenious speculation."

X Equals Y Plus Z!

To the present reviewer the book represents an attempt at wish-fulfillment that is very thinly veiled indeed, and that follows closely the old traditional forms, albeit in terms of the patter of popular physics, and of an indiscriminately hashed assortment of biology. The most essential feature of the Gaskell complex, as I see it, is the archaic doctrine that "the organism is a dual system," composed of a material body, denoted as "Y" by Mrs. Gaskell, and an "immaterial" component, frankly identified with "the soul," and denoted as "Z" ("Zoe"), which suddenly leaves the body at death, for parts presumably unknown. It is the "Z" which organizes "Y" and which completely differentiates all living from all lifeless matter.

As it is the purpose of the book to rationalize "Z" into existence, the author erects a pseudo-scientific structure of protons and electrons, combined in a manner yet unknown to physics, and different from the combinations of proton and electrons known to exist in the atoms of ordinary matter. The primary difference is supposed to consist only in the fact that, in "Z", the electron is much nearer to the proton than is the orbital electron of any known atom. The resulting neutral combination is then conveniently supposed to have such "peculiar" (though not well-specified) physical properties, as would account for its having escaped the detection of physicists hitherto. Such a combination is arbitrarily assumed to be produced when an electron chances to approach too close to a proton, owing to some previous crowding of ions. Having now placed her creature, "Z," entirely in the realm of the unknown, the author has given herself *carte blanche* to make whatever she wishes of it. She supposes it to act as a kind of intra-atomic parasite when it is mixed with ordinary matter, a parasite that causes abnormal growths in its host. For the newly born "Z" (we cannot say "Z-material," since *by definition* this combination cannot be *called* material!) sets to work and manufactures more "Z" by disrupting and appropriating the nuclei of the atoms of the ordinary material around it.

and at the same time it organizes the remainder of the surrounding material into the form of "Y" characteristic of the species. Thus there necessarily (!) result protoplasm, growth, reproduction, mind, etc.*

As to why or how the construction of more "Z" should result from the activity of the first bit of "Z"; as to why or how "Y" should become organized by "Z" so as itself to grow, to reproduce, to differentiate and function *adaptively*, no explanation at all is given, despite a verbose smoke screen which amounts only to an assertion that such *must be* the result: the mechanism is apparently self-evident (to him that hath the wish). Nor is there the slightest shred of evidence that the proposed "Zoe" or "Z" combination could either come into existence as postulated, or have any of the effects attributed to it. The author, however, naively maintains that she has built her theory from the ground up and that it is only in this way that she has arrived at the soul. "Surely," she protests in advance, giving way to a defense reaction, "no man of science would cite the general belief of humanity in the duality of man based on religious beliefs, mysticism, dreams of a wandering double, etc., as negativing my claim to originality for my conception of the organism as a dual system; since my concept is gained exclusively from the facts of the pertinent physical sciences, and the appeal is only to these facts." The emotional background of her rationalizations is clearly revealed in such passages as the following:

> Human motherhood thus acquires a new and peculiar dignity: with the beginning of the soul dating from the same moment as the beginning of the body of her unborn child, indeed holy, and akin to the brooding of Tetragrammaton [explained in glossary to mean Jehovah] over a formless world, are the woman's long days of her *enciente* waiting.

A large part of the book is devoted to a mere rehearsal by the author of what she knows of atomic physics. This may impress the uninitiated, but it is no more than what one can get in any ordinary popular account, and it has no bearing on her "Zoe" phantasy, except insofar as it really emphasizes the total absence of any evidence for the latter. When it comes to the biological side, she is not so systematic in her rehearsal of the already known, and she takes more liberties with actually existing theories. Thus, for example, she argues that egg and sperm are opposite ions which attract one another; that mental precocity testifies to inferior intelligence; that cancer is the result of the birth of a new "Zoe," caused by high ion concentrations; that the erect carriage of man is explained directly by his originally higher "Zoe"; that the successive geological revolutions were times of the spontaneous generation of progressively higher and higher forms of life; and that species are fixed in that they do not evolve one into another.

Evolution Without a Tree

Each species began with its own kind of "Zoe," that was brought into existence by appropriate external conditions; the latter were progressively more complicated with the increasing age of the earth, and hence resulted in "Zoes" of greater and greater potentialities. Each given "Zoe," after being born, went on its predetermined orthogenetic way, through millions of years, to become a now stable species, incapable of further evolution. Whereas Austin Clark has proposed a parallel generation and evolution of different phyla and other "major"

*Let it not be supposed that the recently reported discovery of "neutrons"—nuclei composed of equal numbers of protons and electrons—constitutes a vindication of "Zoe." But, if the report is true, the above claims could soon be put to the test. It is to be expected that such bodies could not be formed by mere crowding of ions, and that they would be inert chemically.

groups, we see that Mrs. Gaskell has outdone him, in postulating a similar independence for every species. True, she admits that by X-rays and other artifices species may become radically changed, but she denies that such events could happen in nature. In support of her disbelief in the geneticist's conception of evolution, she quotes liberally from Bateson—*e. g.*, "As to almost all the essential features, whether of cause or mode, by which specific diversity has become what we perceive it to be, we have to confess an ignorance nearly total" (Bateson, *Problems of Genetics*)—and from Osborne—*e. g.*, "The old paths of research have led nowhere" . . . we must come "away from the matter and form conceptions" of heredity and evolution, and to "an energy conception." . . . "We may imagine that the energy which lies in the life-germ of heredity is very great per unit of mass of the matter which it contains" (Osborn, *The Origin and Evolution of Life*). At this point the reader may find it of interest to refer back to our opening paragraph, there to read the quotation from Pearl, commenting favorably upon Mrs. Gaskell's contribution to the evolution theory.

The Crucial Question

The self-published little book by Krafft, which has no authoritative introduction, and was, he tells us, refused publication by reputable journals, approaches the scientific much more nearly than does that of Gaskell. If it is the product of a psychosis, then the psychosis is that of a "mechanist" rather than that of an animist. Yet in essentials it resembles the book of Gaskell's, for it too must be regarded as a phantasy, in which, at bottom, desire replaces reason.

Krafft's introductory formulation of the problem of life reveals considerable analytical power, and deserves quotation because of its pertinence and soundness:

> The phenomena of growth and reproduction . . . establish in nature a sharp line of demarcation between living and non-living things. Although growth and reproduction, in their broadest aspect, amount to nothing more than self-duplication, yet they are fundamentally different from any of the other processes heretofore known to science.
>
> Biological growth does not proceed in the same manner as the growth of crystals because extensive chemical transformations take place during the process of metabolism whereas the growth of crystals involves no permanent chemical change whatever. It also differs from crystal growth in that the assimilation of food by the cells of living organisms does not require saturated solutions such as are necessary for the growth of crystals . . .
>
> The ultimate cause of life, whether it be a certain substance or a specific detail of physical structure, must be the same for all living organisms because the specific differences which distinguish one living organism from another disappear as we go down the scale of plant or animal life . . .
>
> That the fundamental life processes must be due, either wholly or partly, to specific chemical structures is generally admitted, but there is a prevailing opinion that the chemical configurations which are necessary for this purpose must be extremely complex. The failure of all previous efforts to devise some type of chemical structure which is capable of duplicating itself does not prove, however, that the solution of the problem must lie in the direction of extreme complexity. The complex chemical structures which make up the tissues of the higher plants and animals have developed gradually during the course of evolution, and the fact that they are necessary for the proper physiological functioning of the particular organisms in which they now occur does not prove that they were also the original cause of the incipient life processes in the most primitive submicroscopic forms of life from which these higher plants and animals have developed.

A New Twist

Alas that the promise of this really good introduction remains unfulfilled! What is the simple chemical configuration which the author offers us as giving the clue to the unique property of self-duplication? It is the "spirazine." To manufacture a spirazine artificially (on paper), all you do is to take an ordinary polypeptid molecule (a chain of amino-acids) and twist it into a regular cylindrical spiral, so that the semi-alternate N's of the chain will be opposite one another, on successive rungs of the spiral, and can thus form cross-con-

nections with one another, and so likewise (on occasion) can the semi-alternate CO groups. In this way the spiral becomes tightly bound together across its rungs, like a helical spring that has had two straight strings glued along its outside, crossways of the rungs and parallel with its long axis.

There is nothing inherently improbable in the existence of such twisting and cross-connections; in fact, as Krafft points out, it would be one way of accounting for certain break down products of proteins (the diketopiperazines). But it remains nothing more than one possibility among many. Krafft thinks he is driven to it as the only kind of conformation which will enable a polypeptid (1) to add on new amino-acids without disturbing the arrangement of the old ("growth"), and (2) to become divided up without change of pattern ("division"). As with Mrs. Gaskell, so with Krafft, it is at this crucial point, of growth, that the argument is hastily slurred over, and regarded as self-evident and compelling. Here lies the core of the delusion. This spiralling and these cross-connections—which are the only "contributions" of Kraft—are not only not made necessary by known facts of chemical structure, but, even if they existed, they would not help us in the least to explain growth and reproduction. If a spirally shaped chain can add to itself, there is no apparent reason why a straight one could not do so equally well. But in truth we know at present of no mechanism whereby one can do so, and the "secret" of growth may for all we know lie in some quite different mode of organization than that of polypeptids. The problem of organic growth remains as unsolved as ever.

The hardest jump being thus made by Krafft, it is for him, as for Gaskell, a relatively easy matter to continue the hurdle until every important problem of life—protoplasmic structure, cell division, heredity, consciousness—has been "solved" in similar fashion and at any rate consistently with his original basis. And, as with Gaskell, the further he proceeds the greater become the divergences of his hypotheses from the body of well-grounded theory. Thus, as to heredity, he says:

> When such a change [in a distinguishing characteristic of a species] does take place it is always irreversible and not governed by Mendel's laws, from which it appears that the corresponding alterations in the spirazine pattern of the germ cells must also be irreversible. Such alterations may consist of changes in the total number of spirazines or in their connections with one another through the alpha carbon atoms. On the other hand there are certain minor characteristics, such as the colors and textures of the various body-tissues, which may change freely from generation to generation in accordance with Mendel's laws without involving any permanent change in the nature of the species. Such minor changes take place with equal facility in either direction, from which it appears that the corresponding variations in the spirazine pattern must be completely reversible and must be confined to local changes only, such as the coupling or uncoupling of the adjacent spirazines through their carbonyl and amino groups, so as to produce that peculiar allelomorphism which is characteristic of Mendelian heredity but without producing any permanent change in the spirazine pattern as a whole.

For one at all familiar with genetic principles, such a passage stands self-condemned.

For the securing of energy by the organism, Krafft says the spirazines may "behave like Maxwell's demons" and so defeat the second law of thermodynamics. Unfortunately, organisms have not been observed to exhibit the spontaneous drop in temperature here required, any more than they have been observed to exhibit the spontaneous rise in temperature, unaccounted for by chemical reactions, that would be required by Gaskell's intra-atomic alterations.

Free Will

Turning now to the field of consciousness, we find that Krafft, despite

his mechanism elsewhere, has left a place for "free will." For he says:

> Through the medium of living matter . . . the behaviors of the individual atoms can manifest themselves. In chemically organized structures of this sort some of the atoms may occupy positions of advantage so that their specific individual behaviors may become amplified sufficiently to effect the excitation of nerve or protoplasmic fibres . . . The behaviors of the individual atoms, however, are not subject to the principles of statistical mechanics . . . The responsiveness of living matter to the activities of individual atoms can be readily demonstrated by certain optical experiments . . .

There is no denying the truth of this proposition, *insofar as it goes*, and, in formulating it, Krafft has in essentials anticipated the very argument for "free will" which has recently been given by Arthur Compton in *Science*.*

The trouble with the above argument is that, like the arguments for the "spirazine" and "Zoe," it stops short at the crucial point. For, though the behavior of atoms or electrons is not determined by the laws of statistical mechanics, neither is it known to be "free" in the sense required by the "free will" advocates, if indeed the conception of the latter admits formulation at all. An event must be either determinate, and hence ultimately predictable (from knowledge of *all* prior conditions), or else indeterminate, *i. e.* capricious, haphazard, disorderly, "senseless." The so-called "self-determined" must logically fall in the one class or the other, and, in so far as "reason" enters as a determining (*sic*!) factor, the "self-determined" must certainly be in the first class (the determinate). Why, except through a confusion of ideas, should the second type of behavior (the capricious) seem more desirable to us than the first (the orderly)? And why, except in order to fulfill such an unreasonable wish, should we believe that the second type of behavior (the capricious) really exists? "Accidental events" do certainly exist, in the sense of events determined by causes too numerous or variable for us to compass, or by hidden causes, acting independently of those factors which we can at the time sense, and so giving results that collectively obey the rules of the mathematics of probability. But these events nevertheless fall in the last analysis into the first class, the determinate. And so great has been the success of science, thus far, in ultimately tracing down determinate sequences in "accidental" behavior that when, as in the case of the electron behavior described by Heisenberg's "principle of uncertainty," we find a new case for application of the mathematics of probability, this gives us no right to assume that we are dealing with a case of absolute indetermination, rather than of "caused accident," as defined above.

Certainly, in the case of electron behavior, it has never been shown that there are not other factors than the velocity, position and direction of motion of the electron, and the magnitude, position and direction of the incident quantum, which might help to determine the character of the reaction between them, nor that these other factors may not some time be discovered, perhaps by a more detailed analysis of the very phenomena in question. So, as a purely theoretical example, the direction of recoil, etc., of the electron from a first incident quantum might be found of aid in the prediction of its direction of recoil from a second incident quantum, owing to some peculiar individual conformation or motion (such, for instance, as spinning) that it might possess, but at present factors like the latter are hidden from us because they are independent of the factors of velocity and of original translational direction with which we have been dealing in experiments. I do not wish to be guilty myself, in this hypothetical example, of setting up a phan-

*Compton, A. H. 1931. The Uncertainty Principle and Free Will, *Science*, 74: 172.

tasy as fact: I use it only to show that the opposite conclusion, that of the essential indeterminateness of electron behavior, is as yet far from proved, and that therefore, at this stage of the investigation, the various edifices in the realm of biology, psychology, philosophy and sociology, that are already being constructed thereupon, are the real phantasies. Let us beware lest we be led unwittingly along such lines as those of Krafft and Gaskell!*

Dreams

It may seem that we have devoted too much space to two books like these under review, and indeed the reading of one or two of them is enough for a lifetime. They are of some value, however, as object lessons of what science is not. It is evident that any one of a hundred, or of a hundred thousand, "principles" like that of the "Zoe" or the "spirazine," derived from known or unknown realms of atomic physics, chemistry, theology, or mathematics, if handled in similar fashion, would have served just as well to "explain" the secrets of life and of the universe as would the formulae that these individuals' particular complexes happened to lead them to choose. The method of their application to the problems at issue is essentially that of the subconscious mind.

One of the most eminent biologists of the world has informed me that, on the night before his oral examination for the Ph. D. degree, he dreamt he was defending his dissertation in a spacious hall before an audience which included Darwin and Huxley. After an impressive prelude by the orchestra, he arose and announced: "Ladies and gentlemen, I do not wish to appear immodest, yet it is necessary for me to explain to you that I have really discovered something very profound, in fact it is none other than the secret of life itself. It proves to be startlingly simple and clear, as you will admit on seeing my demonstration." Turning to the blackboard, he drew two triangles, one, labeled ABC, in red chalk, and the other, its mirror-image CBA, in green chalk. "And this, ladies and gentlemen, as you can readily see, is the secret of life." They saw, and all became clear to them; there followed an outbreak of uproarious applause, a triumphant burst from the orchestra, the drop of the curtain, and an anti-climactic awakening. We submit that this mathematical solution deserves a place along with those from atomic physics and from chemistry here being considered.

Speculations

The objection is not that the works under review are speculations, unaccompanied by experiment, but that they are bad speculations, in which wishes first pass for possibilities, then possibilities for probabilities, and finally probabilities for necessities. They contain no search for alternatives, no weighing of chances, but merely flow like fiction. It is such works as these that have done incalculable harm to biology, including the science of heredity, by tending to carry all speculation, *including good speculation,* down into disrepute along with themselves. For another chapter should be written to show into what grievous errors and what shameful delay our science has often been led through the dearth of well-balanced speculation, of harnessed imagination, that recognizes itself for what it is. Whereas good speculation represents one of the highest and most coordinated types of activity of the mind, bad speculation represents one of the least coordinated, worthy only

*Since the above was submitted, similar criticisms of the "free will" interpretation of Heisenberg's principle have been published by Bertrand Russell in "The Scientific Outlook" (1931, Norton and Co.); by William A. Noyes. (1931, "The Uncertainty Principle," *Science*, 74:595-596); and by Henry Morgenau (1931, "The Uncertainty Principle and Free Will," *Science*, 74: 596).

of the subconscious. But at the present time the discrimination between good and bad speculation on the part of the scientific public, has fallen to such a level that it can almost be said that the worse the speculation, the better its reception, as illustrated by comparison of the receptions accorded the works of Gaskell and of Krafft, respectively. At any rate, the more speculation sticks to the known, the more may it be condemned by the specialist in its field, even if it be good, while the *entirely groundless* emendations of the emotionalist may gain the greater approval by virtue of their very defects.

There should of course be a large place in our lives not only for the most rigorous type of ratiocination, but also for more or less unreigned and wholly unfeigned flights of fancy, both for purposes of recreation and stimulation and also to make us aware of distant possibilities and purposes, and of general types of situations which we have not yet met in actuality but for which we should, nevertheless, be not entirely unprepared. This function, however, is not filled by tiresome treatises that parade as actual science. It is filled rather by such frank and full-fledged phantasies, unfortunately all too rare, as are given us in the early stories of H. G. Wells, or in the contemporaneous ones of John Taine.

H. J. Muller.

The "Tasting" Tests

THE samples of paper treated with Phenyl - thio - carbamide, which were sent out with the 1932 bills, produced a remarkable response in family pedigrees of taste reaction, and in requests for additional paper. For a time we were rather swamped by the requests, but ample supplies of treated paper are now available, and any member of the A. G. A. who wishes to make additional tests or to demonstrate the reaction to classes, clubs, etc., can obtain the treated paper from the office of the Association.

We also wish to thank those who have returned family pedigrees. It is hardly possible to acknowledge all of these individually. A large amount of data are being accumulated which throw additional light on the inheritance of taste differences. It is clear that in most cases "tasting" is dominant to "non-tasting," but there are enough inconformities to suggest that modifying factors sometimes inhibit the "taster" gene. This is indicated by the fact that occasionally non-tasters, or very slight tasters, do have children who find the substance definitely bitter.

Much more data are promised by a number of classes in genetics and eugenics, in which extensive tests are being made. When more of this material is available a report will be published in the Journal. In the meantime we have in early prospect an article by Dr. A. F. Blakeslee and Dr. A. L. Fox on the interesting subject of the chemistry and genetics of these heretofore unrecognized sense differences.

There is no question that as an introduction to the study of heredity, or as an interest-arousing preliminary to a lecture on the subject, this reaction has great possibilities. In any considerable group both tasters and non-tasters are sure to be found. After the arguments between them have subsided the difference serves as a pointed text on the subject of Mendelian segregation. In addition to this the substance has other possibilities—we hesitate to call them advantages—as is disclosed by the following letter which resulted from the distribution of the test paper, and which of itself justifies all the difficulties of its preparation. We regret that our correspondent should hide his light of authorship under the bushel of an incognito:

Oconomowoc, Wis.,
January 31, 1932.

American Genetic Association,
Washington, D. C.

Gentlemen:

Say, what the hell you think you're doin' with this here taste stunt? You are breaking

up families & ruining homes & making bad feelings. You are wrecking families what has lived together fer nigh onto 30 years without nothing more serious happenin' than a few fights over goin' to a show & a few dishes broken once in a while in a argument about the wife's relations or cigar ashes on the rug. Yes, & a broken chair once.

When I got yer envelope with the taste stunt I cut off some of thet trick paper and chewed it and it tasted just like ordinary paper to me. And then I called the wife and give her a good chunk of it and she no moren got it in her mouth than she made a face like the minister the time we had him to Sunday dinner and he put vinegar on his puddin instead of syrup. An she spit it out and she was hoppin mad. "Did you eat any of it yeself?" she says and I says "Sure, it tastes all right to me." That made her madder yet and she wouldn't talk to me the rest of the afternoon. So you see what yer tastin done fer me.

And that aint all. Then at supper she comes out high and mighty and says, "If you aint a better taster than that an can't even taste that bitter paper than I been wasting good victuals on you fer 30 years. And I ain't going to waste more of em on you either." You can believe it or not, my meals aint been the same ever since. An I aint been able to change her mind.

So you see that yer trick paper done fer me, me whose always et well for the past 30 years. Its a crime to send thet stuff all over the country & to ruin homes. I bet you ain't took none home to try on yer own wife either. If you have I hope you have caught yours.

You have ruined my life.

Truly,

S. HELP MEGOD.

Books Received

BOOKS are acknowledged in this column as received, and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. As far as space permits, books that contain material of special interest to the readers of the JOURNAL *will be reviewed in later numbers.*

THE FANTASTIC CLAN: THE CACTUS FAMILY, *by* JOHN J. THORNBER and FRANCES BONKER. Pp. XIV + 134. Price $3.50. The Macmillan Co., New York, 1932.

For those who have been bitten by the desert's charm and prickd by its countless thorny plants, this book has many a thrill.

THE PROBLEM OF GENIUS, *by* WILHELM LANGE-EICHBAUM, *translated by* EDITH and CEDAR PAUL. Pp. XIX + 187. Price $3.00. New York Macmillan Co., 1932.

Is genius a biological phenomenon or sociological?—a matter of genes or a pyramiding of hero worship to the *Nth*? Lande-Eichbaum believes that the geniuses of popular imagination are talented individuals, yes, but super-individuals—a figment of the collective imagination! While this may in some instances be admitted, nevertheless it is true that the range of talent is great—and that an arbitrary classification as "Genius" or "talent" is purely a verbal abstraction.

THE CULTURE OF THE ORANGE AND ALLIED FRUITS, *by* H. CLARK POWELL, Prof. of Horticulture, University of Pretoria, South Africa. Pp. 355, 83 illustrations, two maps. Price one pound, one shilling net, South Africa Central News Agency, Ltd., 1930. Johannesburg.

A very extensive handbook on citrus culture in South Africa especially, and in other citrus growing regions in general.

NEW MINDS: NEW MEN? The Emergence of the Soviet Citizen, *by* THOMAS WOODY. Pp. IVI + 528, many illustrations. Price $4.00. Macmillan Co., New York, 1932.

Mr. Woody summarizes twenty months of observation of the Soviet Union with a question-mark in the title and this opening text:

"Do you remember, I asked you then, 'will there be men among us?' And you answered 'There will be.' Oh, Black-earth force! And so now, from here, from my 'beautiful distance' once more I ask you: Well now, Uvar Ivanovitch, 'will there be?'

"Uvar Ivanovitch wriggled his fingers and fixed his enigmatic eyes upon the distance."

More enigmas out of Russia!

PARTIAL TWINNING IN A HEREFORD CALF

Figure 10

Twinning tendencies, expressed at various stages of embryonic development too late to result in separate twins, produce double monsters, ranging in degrees of completeness from "Siamese Twins" to individuals with double heads, or only with double faces. This case is of interest because the monster is not completely symmetrical, as is usually the case. It has two heads, necks, and tails, but only six feet. This partial twin calf was born recently on the ranch of D. F. Urstbel, near Canadian, Texas. Mr. Fred L. Frass, ranch manager, kindly furnished the photograph. The skin has been stuffed and Mr. Frass is willing to dispose of it to an institution interested in the purchase and preservation of such a specimen.

MENTAL DEFICIENCY IN GREAT BRITAIN

Report of the Mental Deficiency Committee, being a Joint Committee of the Board of Education and the Board of Control, London, H. M. Stationery Office. 1929.

THE extensive report of the Mental Deficiency Committee contains a wealth of material which will be of interest to all students of eugenics. Some day the people of Great Britain may be stirred to do something really effective toward reducing their burden of defective humanity, but at present they seem to be doing everything they can to increase it. The English people, like those of other countries, are not sufficiently aware of the evils which result from their apparently increasing population of subnormals. In general the intellectual classes seem to be even more ignorant of biology and its bearings on social problems than those of our own country. Nevertheless, Great Britain is in advance of most countries of Europe except perhaps Norway, Sweden and Germany. Eugenically France is hopeless and Italy is even worse. As to other countries there is little to modify one's conviction that so far as eugenics is concerned we are living in a benighted world. I have recently been informed that even in England some very simple talks on heredity over the radio evoked a considerable amount of protest not only from scandalized individuals but from a number of organized groups. This information afforded me quite a shock and naturally called to mind the opposition to the teaching of evolution in the backward sections of our own country.

The report we have mentioned is a valuable educational document which it is hoped, will have its influence in enlightening the public. Of course very few people will read it, but it will have to be considered by the important few who are entrusted with the responsibility of dealing with the defective elements of the population. It aims first of all to give the number of mental defectives in certain fairly typical areas of Great Britain. For their investigations the Committee selected six areas, each containing about 100,000 inhabitants. Three of these were urban, two rural and one partly urban and partly rural. Through the cooperation of local officials, social workers, physicians and school authorities a large amount of information was collected in regard to all sorts of defectives, whether feeble-minded, epileptic or insane, in the regions investigated. An intensive study was made of the schools and of various institutions in which defectives were confined and no child was rated as a mental defective unless he was so regarded by the head teacher, and was also so classed on the basis of group tests and on independent examination by the medical investigator.

The whole report consists of four parts published in three volumes. The first part deals with the general plan of the investigation, the nature of mental defect, and a review of legislation on mental defectives. The second part on the Mentally Defective Child is concerned with present provisions for mentally defective children, the general findings of the Committee, the relation between defective and retarded children, and suggested administrative and educational reforms in the care and training of defective children. Out of a population of 623,000 in the areas studied the total number of defectives of all ages was 5,334, or 8.56 per 1,000. The total percentage of mental defectives was found to be higher in rural than in urban areas in the ratio of 10.49 in the former to 6.71 in the latter. If the percentage of defectives in the whole country were the same as in these areas there would be in England and Wales 288,600 de-

fectives of which 202,600 would be urban and 86,000 rural. Making allowance for the inclusion of some defectives whose condition should be attributed to faulty education and also for the exclusion of a certain number of adult defectives not certified as such, the Committee concludes that mental defectives constitute approximately 8.00 per 1,000 of the total population. This proportion is about twice as high as that found by the Royal Commission on Feeble-Mindedness whose report was published in 1908.

Much of the increase in defectives indicated by these two reports is attributed to a more complete ascertainment of defectives in the later survey and to saving more lives during infancy and childhood in the defective classes. It is of interest, however, that the percentage of low grade defectives, idiots and imbeciles is also about twice as high as in 1908. Inasmuch as it is not probable that many of this low group escaped detection, this increase affords a certain presumption in favor of the conclusion that the increase of the higher forms of feeble-mindedness may be, at least in part, real. It was also found that the disparity in the proportions of defectives in urban and in rural areas had also increased. Although the Committee is very careful in drawing conclusions, the statement is made after discussing various other explanations of its findings that "after due allowance has been made for these and other considerations to which great weight must be attached, the facts that (1) our investigation revealed twice as many lower grade defectives as did that of the Royal Commission twenty years previously, (2) that the ratio of the different grades to each other remains the same in the two inquiries, and (3) that the disparity in the ascertained incidence in the urban and rural areas has markedly increased — all these make it hard to believe that there has not been some increase in the incidence of mental deficiency during this period."

The high percentage of defectives in rural areas cannot be explained, in the opinion of the Committee, as a result of more complete enumerations since the disparity was most pronounced in the school population which was studied with especial care. It is noteworthy that the lower grades of defect were 40 per cent more frequent in rural areas. The explanation of rural defectives most favored by the Committee is that "the selective migrataion of the better stock from the rural districts has left behind a population inferior in mental quality at any rate and that the intermarriage of this inferior stock has produced a larger number of mental defectives during the last 50 years than in previous centuries when the population was more evenly distributed." This appears to be a very probable explanation and certain studies indicate that it applies to a number of cases of rural degeneracy in the United States.

In Chapter V of part III there is a discussion of Mental Defect as a Genetic and Social Problem. Mental defect, which is conceded to be hereditary in a large proportion of cases, is a "group problem." While some defectives are found in the best families, the great majority arise from inferior stock. A collection of families including mental defectives "would include as everyone who has extensive practical experience of social service would readily admit, a much larger proportion of insane persons, epileptics, paupers, criminals (especially recidivists) unemployables, habitual slum dwellers, prostitutes, inebriates and other social inefficients than would a group of families not containing mental defectives. The overwhelming majority of the families thus collected will belong to that section of the community, which we propose to term the social problem, or subnormal group. This group comprises approximately the lowest 10

per cent in the social scale of most communities." Many of these people may be emotionally deficient or unstable instead of feeble-minded and hence become social problems.

The problem of how to reduce this burden inevitably forced itself upon the attention of the Committee and it is discussed in the usual careful and conservative way. Sterilization, even if it were thoroughly applied, would not, it is claimed, effect much reduction. In general the Committee regards it with disfavor, although its attitude is that of open-mindedness instead of the more usual one of dogmatic opposition. One objection is that if parents were aware that their children might possibly be sterilized they would be less likely to allow them to be taken under public control and "the certifying Officer would be more reluctant to issue his certificate and the Magistrate would be less willing to make the Order." As a matter of fact the process has not worked out in this way in the United States. Parents who recognize the mental defect of their children are often desirous of having them sterilized so that they cannot transmit their defect, and with more enlightenment on the subject such an attitude would probably become more common.

The Committee states that "A more cogent ground for advocating sterilization is that its application would ease the economic burden by enabling defectives who would otherwise have to be permanently segregated in institutions to return to the community with no risk of their becoming parents, and that a number of them could live happily and harmoniously outside institutions. If it could be proved that sterilization could safely and profitably be applied even to certain groups or categories of defectives, the question of its adoption would no doubt deserve careful attention."

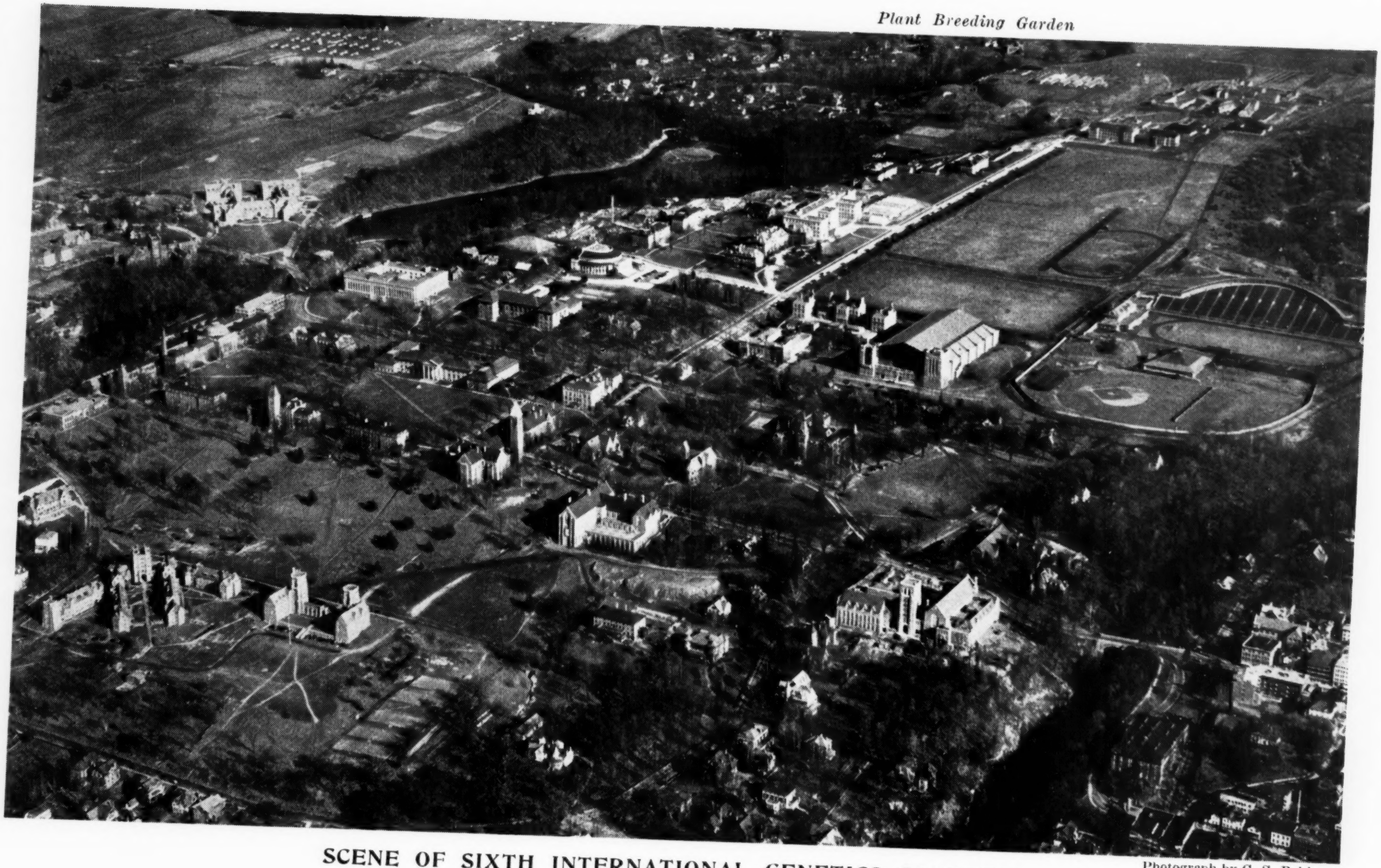
The references to the effect of sterilization in California indicate that the Committee had not availed itself of the recent studies of Popenoe on the effects of the operations in that state or it could not have referred to the system of discharge after sterilization as a "failure." On the contrary the results of sterilization combined with supervision go a long way toward justifying this procedure according to the admission of the Committee.

The fourth and largest section of the report is that of Dr. E. O. Lewis whose investigations with those of his co-workers furnished much of the material employed in the preceding sections. This accounts for quite a good deal of repetition found in different parts of the report. It would be impossible within a short space to give an account of the detailed information given in Dr. Lewis' report. Physical defects including undersize, malnutrition, rickets, defects of sight and hearing, epilepsy and other nervous disorders were very much more prevalent among mental defectives than among normal children. As might be expected a close relationship was found between mental defect and illegitimacy. In the Eastern Counties area the 196 mentally defective women had given birth to 118 illegitimate children.

The study of family histories was a more or less incidental feature of the investigation, nevertheless considerable information was gathered which showed a marked tendency for several mental defectives to occur in the same family. This tendency was more pronounced among the ordinary cases of feeble-mindedness than in cases of idiocy and imbecility which seem to be more sporadic in their distribution.

S. J. Holmes.

Plant Breeding Garden



SCENE OF SIXTH INTERNATIONAL GENETICS CONGRESS

Photograph by C. S. Robinson

Figure 10

Airplane view of Cornell University campus and environs, where will be held the Sixth International Genetics Congress from August 24 to 31, 1932. Willard Straight Hall, the headquarters of the Congress, is in the center of the picture. The live plant exhibits will be grown in the Plant Breeding Garden, which can be seen at the upper right, in the low ground beyond the University buildings. Already there are over five hundred members in the Congress. A fine program and remarkable exhibits are assured.

The Sixth International Congress of Genetics

Ithaca, New York, August 24-31, 1932

BECAUSE of the world-wide economic depression, the question of postponing the Congress forced itself on the Council as an unavoidable issue requiring immediate decision. After the most careful study of the present situation and the extremely uncertain limits of its duration, the Council unanimously decided to proceed with plans for holding the Congress on the dates originally planned, August 24-31, 1932.

Since, however, there had been uncertainty in the minds of some scientists as to whether the Congress would be held, and since this uncertainty might have led a number of potential members to delay in sending in their dues, the Council decided to take special action on memberships as follows:

It was voted to extend the date up to which members from the United States and Canada could join at the lower rate of $10.00 for full membership and $6.00 for student membership to May 1, 1932. It was further voted that the dues for these two classes of members after that date should be $12.00 and $7.00 respectively. It will be recalled that foreign memberships remain at $10.00 up to date of the Congress. The present quota of members of all classes is over five hundred.

Transportation

The Red Star Line finds it neces-- sary to substitute the S. S. Westernland for the S. S. Pennland which we wished to use as the official steamer of the Congress. Since these two steamers are sister ships and practically identical, the change is of no importance. It is merely a change in name, and nothing else. The date for arrival in New York City is now set definitely as Sunday, August 21st. This will necessitate a change in the plans for New York entertainment, which will be announced later. It will not affect the offer of Columbia University and the Carnegie Endownment to entertain the foreign delegates during their stay in New York City.

In addition to a post-Congress excursion to New England and possibly one to Washington, D. C., (Congress Quarterly, Vol. I, No. 4, p. 3), the following trip has been suggested by Professor Huskins of the Department of Botany of McGill University, Montreal, Canada. A trip from Ithaca to Buffalo, Niagara Falls, Toronto, thence by steamer through the Thousand Islands to Prescott, and by rail again to Ottawa, Lucerne-in-Quebec, Montreal, Quebec, and New York, will cost about $45. McGill University offers hospitality for a couple of days for those who are interested in this trip.

Program

The program committee is progressing in arranging its material. Its chairman estimates that over two hundred papers and demonstration papers will be presented. It is planned that a number of morning meetings will be held dealing with topics of general interest such as "The Relation of Cytology and Genetics," "Mutations," "Species Hybrids" and "Genetics and Evolution." There may be changes in, or additions to, these topics. The afternoons will largely be given over to special section meetings at which the more specialized topics will be discussed, probably according to the experimental material used.

These afternoon meetings will, in no way, be considered of less importance than the morning meetings. They represent the reports of advances on the various frontiers of genetic knowledge. The morning

papers are in the nature of general discourses on fields of research rather than on specific problems. Both types of contribution are absolutely essential to the success of the conference.

The knowledge that Dr. T. H. Morgan, President of the Congress, is recovering from a very serious accident met while automobiling, and that he will be able to participate in the Congress, has removed a great source of grave concern and worry from the minds of geneticists the world over.

Exhibits

Material is already being grown for a part of the exhibit of living material to illustrate many of the principles and advances in plant genetics. It is hoped that this exhibit may be one of the outstanding features of the Congress.

Progress is also being made in the exhibits of other fields of genetic research. It is confidently hoped and expected that the work of every genetics laboratory in the United States and Canada will be exhibited and that material will also be received from many European and foreign laboratories. The interest already shown and the material promised make certain an exhibition, original in plan, and unique in extent.

Lodging for Members at Ithaca

The Administration of Cornell University has quoted rates in residential halls for a period of 4-7 days, of $1.75 per day. Private rooming houses, adjoining the campus quote rates of from $1.00 to $1.50 per day, depending on the facilities offered and length of occupancy. It is planned to publish, during the early summer, a more detailed survey of facilities and rates for the information of members. The replies to this will serve as a guide in making final arrangements.

Membership

The dues for personal membership in the Congress for residents of the United States and Canada are $10.00 if paid before May 1, and $12.00 if paid after that time. The dues of members from other countries are $10.00, payable at the time of the Congress. Membership includes a copy of the Proceedings of the Congress. Other classes of membership are: Student Membership, $6 until May 1, $7.00 after May 1; Sustaining, $100; Institutional, $100; Patrons, $1,000. Application for membership may be forwarded to the Treasurer of the Congress, Robert Cook, 306 Victor Building, Washington, D. C. Additional information regarding the Congress may be obtained from the Secretary General, C. C. Little, Jackson Memorial Laboratory, Bar Harbor, Maine.

PERSONAL MEMBERSHIP APPLICATION FORM

C. C. Little, *Secretary*, Sixth International Genetics Congress, Jackson Memorial Laboratory, Bar Harbor, Maine.

Dear Sir: Please enroll me as a member of the Sixth International Genetics Congress. This gives me the right to attend all the meetings of the Congress, and to receive the *Proceedings* and other publications of the Congress.

☐ I enclose $5 as payment of half my dues, and will remit the balance ($5) at the time of the Congress.
☐ I enclose $10 in full payment of dues.

Name .....

Street and No. .....

City, State and Country .....

Checks should be made payable to the Sixth International Genetics Congress

Please forward Application with remittance to Robert Cook, Treas., 306 Victor Building, Washington, D. C.